THE Celestial Worlds DISCOVER'D: OR, CONJECTURES Concerning the INHABITANTS, PLANTS and PRODUCTIONS OF THE Worlds in the Planets.

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Written in Latin by
CHRISTIANUS HUYGENS,
And inscrib'd to his Brother
CONSTANTINE HUYGENS,
Late Secretary to his Majesty K. *William*.

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C 7 1611

TO THE READER.

THIS Book was juſt finiſhed, and deſigned for the Preſs, when the Author, to the great loſs of the Learned World, was ſeized by a Diſeaſe that brought him to his Death. However he took care in his laſt Will of its Publication, deſiring his Brother, to whom it was writ, to take that Trouble upon him. But he was ſo taken up with Buſineſs and Removals, (as being Secretary in *Holland* to the King of *Great Britain*) that he could find no time for it till a year after the Death of the Author: When it ſo fell out, that the Printers being ſomewhat tardy, and this Gentleman dying, the Book was left without either Father or Guardian. Yet it now ventures into the Publick, in the ſame method that it was writ by the Au-

thor, and with the ſame Inſcription to his Brother, tho dead; in confidence that this laſt Piece of his will meet with as kind a reception from the World as all the other Works of that Author have. 'Tis true there are not every where Mathematical Demonſtrations; but where they are wanting, you have probable and ingenious Conjectures, which is the moſt that can be reaſonably expected in ſuch matters. What belongs to, or has any thing to do with Aſtronomy, you will ſee demonſtrated, and the reſt ingeniouſly and ſhrewdly gueſs'd at, from the affinity and relation of the heavenly Bodies to the Earth. For your farther Satisfaction read on, and farewel.

THE

THE PUBLISHER TO THE READER.

I Doubt not but I ſhall incur the Cenſures of learned Men for putting this Book into Engliſh, becauſe, they'l ſay, it renders Philoſophy cheap and vulgar, and, which is worſe, furniſhes a ſort of injudicious People with a ſmattering of Notions, which being not able to make a proper uſe of, they pervert to the Injury of Religion and Science. I confeſs the Allegation is too true: but after Biſhop Wilkins, *Dr.* Burnet, *Mr.* Whiſton, *and others, to ſay nothing of the antient Philoſophers, who wrote in their own Tongues; I ſay after theſe great Authors have treated on as learned and abſtruſe Subjects in the ſame Language,*

I hope their Example will be allowed a ſufficient excuſe for printing this Book in Engliſh.

Concerning this Edition I can ſay, that I have taken care to have the Cuts exactly done, and have plac'd each Figure at the Page of the Book that refers to it, which I take to be more convenient to the Reader than putting 'em all at the end.

I have been careful to procure the beſt Paper; that I might in ſome meaſure come up to the Beauty of the Latin Edition, tho this bear but half the Price of it.

And I hope the Tranſlator has expreſs'd the Author's Senſe aright, and has not committed Faults beyond what an ingenuous Reader can pardon.

By the Corrector's fault *Knowlege* is ſpelt thro-out the Book without a *d*.

NEW

Spherical, and to be ſurrounded Book 1.
h Air, even then there were ſome
nen ſo bold as to affirm, there were
n innumerable company of Worlds
the Stars. But later Authors, ſuch
as Cardinal *Cuſanus*, *Brunus*, *Kepler*, (and if we may believe him, *Tycho* was of that opinion too) have furniſh'd the Planets with Inhabitants. Nay, *Cuſanus* and *Brunus* have allow'd the Sun and fixed Stars theirs too. But this was the utmoſt of their boldneſs; nor has the ingenious French Author of the Dialogues about *the Plurality of Worlds* carry'd the buſineſs any farther. Only ſome of them have coined ſome pretty Fairy Stories of the Men in the Moon, juſt as probable as *Lucian*'s true Hiſtory; among which I muſt count *Kepler*'s, which he has diverted us with in his Aſtronomical Dream. But a while ago thinking ſomewhat ſeriouſly of this matter (not that I count my ſelf quicker ſighted than thoſe great Men, but that I had the happineſs to live after moſt of them) methoughts the enquiry was not ſo impracticable, nor the way ſo

Some have already talk'd of the Inhabitants of the Planets, but went no farther.

Book 1. ſtopt up with Difficulties, but th there was very good room left for pro bable Conjectures. As they came in to my head, I clapt them down int common places, and ſhall now try t digeſt them into ſome tolerable Method for your better conception of them, and add ſomewhat of the Sun and Fixt Stars, and the Extent of that Univerſe of which our Earth is but an inconſiderable point. I know you have ſuch an eſteem and reverence for any thing that belongs to Heaven, that I perſwade my ſelf you will read what I have written without pain: I'm ſure I writ it with a great deal of pleaſure; but as often before, ſo now, I find the ſaying of *Archytas* true, even to the Letter, *That tho a Man were admitted into Heaven to view the wonderful Fabrick of the World, and the Beauty of the Stars, yet what would otherwiſe be Rapture and Extaſie, would be but a melancholy Amazement if he had not a Friend to communicate it to.* I could wiſh indeed that all the World might not be my Judges, but that I might chuſe my Readers, Men like you, not ignorant

NEW CONJECTURES Concerning the Planetary Worlds, THEIR INHABITANTS AND PRODUCTIONS.

Written by CHRISTIANUS HUYGENS, and inscrib'd to his Brother CONSTANTINE HUYGENS.

BOOK the First.

A Man that is of *Copernicus*'s Opinion, that this Earth of ours is a Planet, carry'd round and enlighten'd by the Sun, like the rest of them, cannot but

Book 1. ſometimes have a fancy, that it's not improbable that the reſt of the Planets have their Dreſs and Furniture, nay and their Inhabitants too as well as this Earth of ours: Eſpecially if he conſiders the later Diſcoveries made ſince *Copernicus*'s time of the Attendents of *Jupiter* and *Saturn*, and the Champain and hilly Countrys, in the Moon, which are an Argument of a relation and kin between our Earth and them, as well as a proof of the Truth of that Syſtem. This has often been our talk, I remember, good Brother, over a large Teleſcope, when we have been viewing thoſe Bodies, a ſtudy that your continual buſineſs and abſence have interrupted for this many years. But we were always apt to conclude, that 'twas in vain to enquire after what Nature had been pleaſed to do there, ſeeing there was no likelihood of ever coming to an end of the Enquiry. Nor could I ever find that any Philoſophers, thoſe bold Heros, either antient or modern, ventur'd ſo far. At the very birth of Aſtronomy, when the Earth was firſt aſſerted to be

ignorant in Aſtronomy and true Philoſophy; for with ſuch I might promiſe my ſelf a favourable hearing, and not need to make an Apology for daring to vent any thing new to the World. But becauſe I am aware what other hands it's likely to fall into, and what a dreadful Sentence I may expect from thoſe whoſe Ignorance or Zeal is too great, it may be worth the while to guard my ſelf beforehand againſt the Aſſaults of thoſe ſort of People. Book 1.

The Objections of ignorant Cavillers prevented.

There's one ſort who knowing nothing of Geometry or Mathematicks, will laugh at it as a whimſical and ridiculous undertaking. It's mere Conjuration to them to talk of meaſuring the Diſtance or Magnitude of the Stars: And for the Motion of the Earth, they count it, if not a falſe, at leaſt a precarious Opinion; and no wonder then if they take what's built upon ſuch a ſlippery Foundation for the Dreams of a fanciful Head and a diſtemper'd Brain. What ſhould we anſwer to theſe Men, but that their Ignorance is the cauſe of their Diſlike, and that if they had more Senſe they

Book 1. would have fewer Scruples? But few people having had an opportunity of proſecuting theſe Studies, either for want of Parts, Learning, or Leiſure, we cannot blame their Ignorance; and if they reſolve to find fault with us for ſpending time in ſuch matters, becauſe they do not underſtand the uſe of them, we muſt appeal to properer Judges.

Theſe Conjectures do not cnotradict the holy Scriptures.

The other ſort, when they hear us talk of new Lands, and Animals endued with as much Reaſon as themſelves, will be ready to fly out into religious Exclamations, that we ſet up our Conjectures againſt the Word of God, and broach Opinions directly oppoſite to Holy Writ. For we do not there read one word of the Production of ſuch Creatures, no not ſo much as of their Exiſtence; nay rather we read the quite contrary. For, That only mentions this Earth with its Animals and Plants, and Man the Lord of them; but as for Worlds in the Sky, 'tis wholly ſilent. Either theſe Men reſolve not to underſtand, or they are very ignorant; For they have been

been anſwer'd ſo often, that I am al- Book 1.
moſt aſham'd to repeat it: That it's
evident God had no deſign to make a
particular Enumeration in the Holy
Scriptures, of all the Works of his
Creation. When therefore it is plain
that under the general name of *Stars*
or *Earth* are comprehended all the
Heavenly Bodies, even the little Gen-
tlemen round *Jupiter* and *Saturn*, why
muſt all that multitude of Beings
which the Almighty Creator has been
pleaſed to place upon them, be ex-
cluded the Privilege, and not ſuffer'd
to have a ſhare in the Expreſſion?
And theſe Men themſelves can't but
know in what ſenſe it is that all things
are ſaid to be made for the uſe of Man,
not certainly for us to ſtare or peep
through a Teleſcope at; for that's lit-
tle better than nonſenſe. Since then
the greateſt part of God's Creation,
that innumerable multitude of Stars, is
plac'd out of the reach of any man's
Eye; and many of them, it's likely,
of the beſt Glaſſes, ſo that they don't
ſeem to belong to us; is it ſuch an un-
reaſonable Opinion, that there are

Book I. ſome reaſonable Creatures who ſee and admire thoſe glorious Bodies at a nearer diſtance?

This Enquiry not over-curious.

But perhaps they'll ſay, it does not become us to be ſo curious and inquiſitive in theſe things which the Supreme Creator ſeems to have kept for his own knowlege: For ſince he has not been pleaſed to make any farther Diſcovery or Revelation of them, it ſeems little better than preſumption to make any inquiry into that which he has thought fit to hide. But theſe Gentlemen muſt be told, that they take too much upon themſelves when they pretend to appoint how far and no farther Men ſhall go in their Searches, and to ſet bounds to other Mens Induſtry; juſt as if they had been of the Privy Council of Heaven: as if they knew the Marks that God has plac'd to Knowlege: or as if Men were able to paſs thoſe Marks. If our Foreſathers had been at this rate ſcrupulous, we might have been ignorant ſtill of the Magnitude and Figure of the Earth, or of ſuch a place as *America*. The Moon might have ſhone

ſhone with her own Light for all us, and we might have ſtood up to the ears in Water, like the *Indians* at every Eclipſe: and a hundred other things brought to light by the late Diſcoveries in Aſtronomy had ſtill been unknown to us. For what can a Man imagine more abſtruſe, or leſs likely to be known, than what is now as clear as the Sun? That vigorous Induſtry, and that piercing Wit were given Men to make advances in the ſearch of Nature, and there's no reaſon to put any ſtop to ſuch Enquiries. I muſt acknowlege ſtill that what I here intend to treat of is not of that nature as to admit of a certain knowlege; I can't pretend to aſſert any thing as poſitively true (for that would be madneſs) but only to advance a probable gueſs, the truth of which every one is at his own liberty to examine. If any one therefore ſhall gravely tell me, that I have ſpent my time idly in a vain and fruitleſs enquiry after what by my own acknowlegement I can never come to be ſure of; the anſwer is, that at this rate he would put down all Natu- Book 1.

Book 1. Natural Philoſophy as far as it concerns it ſelf in ſearching into the Nature of things: In ſuch noble and ſublime Studies as theſe, 'tis a Glory to arrive at Probability, and the ſearch it ſelf rewards the pains. But there are many degrees of Probable, ſome nearer Truth than others, in the determining of which lies the chief exerciſe of our Judgment. But beſides the Nobleneſs and Pleaſure of the Studies, may not we be ſo bold as to ſay, they are no ſmall help to the advancement of Wiſdom and Morality? ſo far are they from being of no uſe at all. For here we may mount from this dull Earth, and viewing it from on high, conſider whether Nature has laid out all her coſt and finery upon this ſmall ſpeck of Dirt. So, like Travellers into other diſtant Countrys, we ſhall be better able to judg of what's done at home, know how to make a true eſtimate of, and ſet its own value upon every thing. We ſhall be leſs apt to admire what this World calls great, ſhall nobly deſpiſe thoſe Trifles the generality of Men ſet their Affections on,

Conjectures not uſeleſs, becauſe not certain.

Theſe Studies uſeful to Religion.

on, when we know that there are a multitude of ſuch Earths inhabited and adorned as well as our own. And we ſhall worſhip and reverence that God the Maker of all theſe things; we ſhall admire and adore his Providence and wonderful Wiſdom which is diſplayed and manifeſted all over the Univerſe, to the confuſion of thoſe who would have the Earth and all things formed by the ſhuffling Concourſe of Atoms, or to be without beginning. But to come to our purpoſe. Book I.

Copernicus's Syſtem explain'd.

And now becauſe the chief Argument for the proof of what we intend will be taken from the diſpoſition of the Planets, among which without doubt the Earth muſt be counted in the Copernican Syſtem, I ſhall here firſt of all draw two Figures. The firſt is a Deſcription of the Orbs the Planets move in, in that order that they are placed round the Sun, drawn as near as can be in their true Proportions, like what you have ſeen in my Clock at home. The ſecond ſhows the Proportions of their Magnitudes in reſpect of one another and of the Sun,

Book 1. Sun, which you know is upon that ſame Clock of mine too. In the firſt the middle Point or Center is the Place of the Sun, round which, in an order that every one knows, are the Orbits of *Mercury*, *Venus*, the Earth with that of the Moon about it; then thoſe of *Mars*, *Jupiter* and *Saturn*: and about the two laſt the ſmall Circles that their Attendents march in: about *Jupiter* four, and about *Saturn* five. Which Circles as well as that of the Moon are drawn larger than their true Proportion would admit, otherwiſe they could not have been ſeen. You may eaſily apprehend the Vaſtneſs of theſe Orbits by this, that the diſtance of the Earth from the Sun is ten or twelve thouſand of the Earth's Diameters. Almoſt all theſe Circles are in the ſame Plane, declining very little from that in which the Earth moves, call'd *the Plane of the Ecliptick*. This Plane is cut obliquely by the Axis upon which the Earth turns it ſelf round in 24 hours, whence ariſe the Succeſſions of Day and Night; The Axis of the Earth always keeping

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Fig: 1

p. 12.

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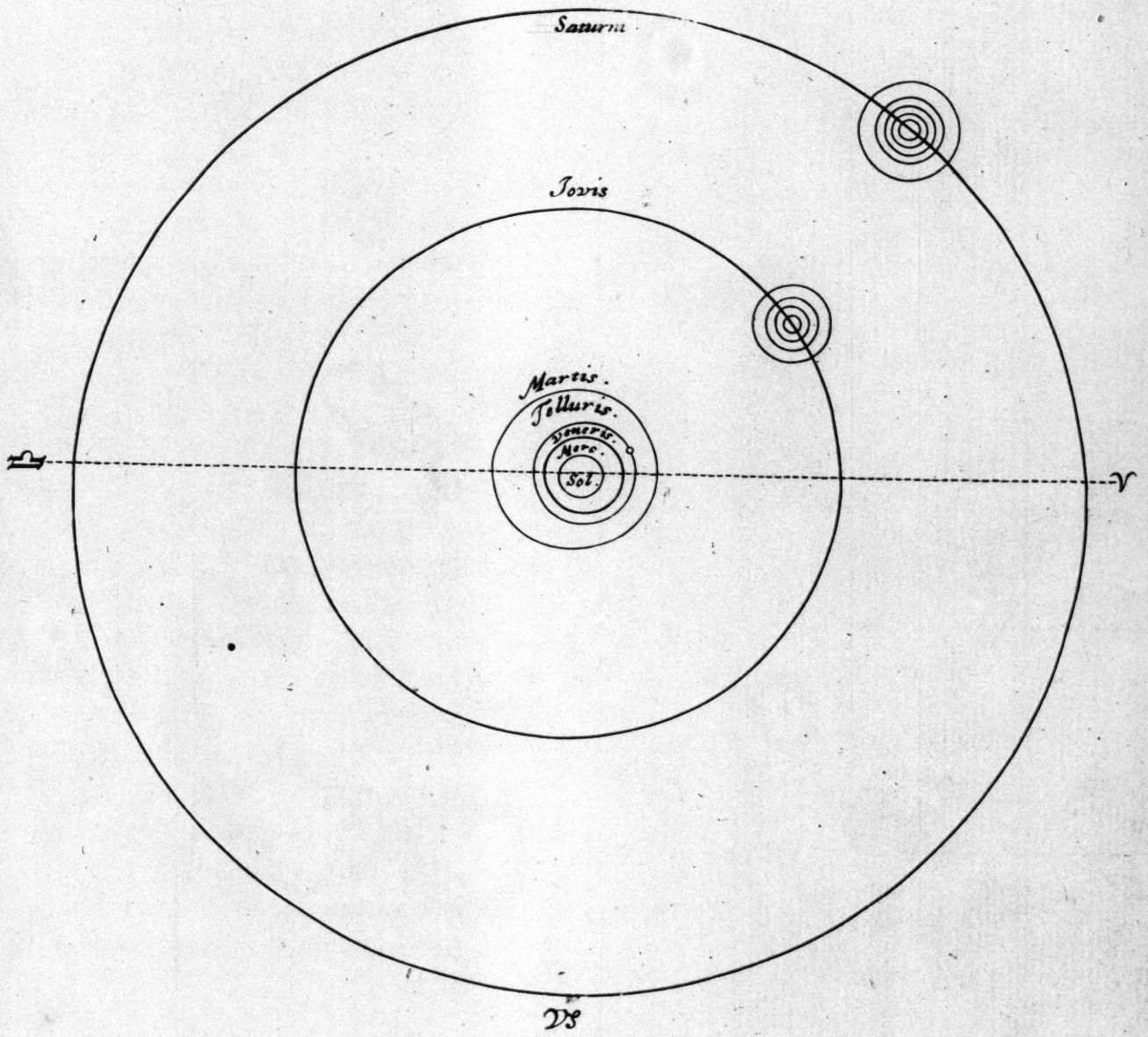

ing the ſame Inclination to the Eclip- Book 1.
tick (except a ſmall change beſt known to Aſtronomers) while the Earth it ſelf is carry'd in its yearly Courſe round the Sun, cauſes the regular Order of the Seaſons of the Year: as you may ſee in all Aſtronomers Books. Out of which I ſhall tranſcribe hither the Periods of the Revolutions of the Planets, *viz. Saturn* moves round the Sun in 29 Years, 174 Days, and 5 Hours: *Jupiter* finiſhes his Courſe in 11 Years, 317 Days, and 15 Hours: *Mars* his in about 687 Days. Our Year is 365 Days 6 Hours: *Venus*'s 224 Days 18 Hours: and *Mercury*'s 88 Days. This is the now commonly receiv'd Syſtem, invented by *Copernicus*, and very agreeable to that frugal Simplicity Nature ſhows in all her Works. If any one is reſolved to find fault with it, let him firſt be ſure he underſtands it. Let him firſt ſee in the Books of Aſtronomers with how much greater eaſe and plainneſs all the Motions of the Stars, and Appearances in the Heavens are explained and demonſtrated in this than either in that

Arguments for the truth of it.

Book 1. that of *Ptolomy* or *Tycho*. Let him consider that Discovery of *Kepler*, that the distances of the Planets from the Sun, as well of the Earth as the rest, are in a fixt certain proportion to the times they spend in their Revolutions. Which Proportion it's since observed that their Satellites keep round *Jupiter* and *Saturn*. Let him examine what a contradictory Motion they are fain to invent for the solution of the Polar Star's changing its distance from the Pole. For that Star in the end of the Little Bear's Tail which now describes so small a Circle round the Pole, that it is not above two Degrees and twenty Minutes, was observed about 1820 Years ago, in the time of *Hipparchus*, to be above 12: and will within a few ages more be forty five Degrees distant from it: and after 25000 years more will return to the same place it is now in. Now if with them we allow the Heavens to be turned upon their own Axis, at this rate they must have a new Axis every day: a thing most abominably absurd, and repugnant to the nature of all motion. Where-

as

Fig. 2.

Sol.

Sat.

Jup.

Mars

Tellus

Venus

Merc

as nothing is easier with *Copernicus* than to give us satisfaction in this matter. Then he may impartially weigh those Answers that *Galilæus*, *Gassen-* [illegible] *Kepler*, and others have given to [illegible] objections proposed, which have so [illegible] ed all Scruples, that generally all [illegible] others now adays are brought [illegible] our side, and allow the Earth [illegible] Motion and Place among the Planets. If he cannot be satisfied with all this, he is either one whose Dulness can't comprehend it, or who has his Faith at another man's disposal, and so for fear of *Galileo*'s fate dare not own it.

Book 1.

In the other Figure you have the Globes of the Planets, and of the Sun, represented to your eyes as plac'd near one another. Where I have observ'd the same Proportion, of their Diameters to that of the Sun, that I publish'd to the World in my Book of *the Appearances of Saturn*: namely, the Diameter of the Ring round *Saturn* is to that of the Sun as 11 is to 37; that of *Saturn* himself about as 5 to 37; that of *Jupiter* as 2 to 11; that of

The Proportion of the Magnitude of the Planets, in respect of one another, and the Sun.

Book 1. of *Mars* as 1 to 166; of the Earth as 1 to 111; and of *Venus* as 1 to 84: to which I ſhall now add that of *Mercury* obſerv'd by *Hevelius* in the Year 1661, but calculated by my ſelf, and found to be as 1 to 290.

If you would know the way that we came to this knowledg of their Magnitudes, by knowing the Proportion of their Diſtances from the Sun, and the meaſure of their Diameters, you may find it in the Book beforementioned: and I cannot yet ſee any reaſon to make an alteration in thoſe I then ſettled, altho I will not ſay they are without their faults. For I can't yet be of their mind, who think the uſe of Micrometers, as they call them, is beyond that of our Plates, but muſt ſtill think that thoſe thin Plates or Rods of which I there taught the uſe, not to detract from the due praiſes of ſo uſeful an Invention, are more convenient than the Micrometers.

The Lamellæ more convenient than Micrometers.

In this Proportion of the Planets it is worth while to take notice of the prodigious Magnitude of the Sun in compariſon with the four innermoſt, which

which are far leſs than *Jupiter* and *Saturn.* And 'tis remarkable, that the Bodies of the Planets do not increaſe together with their diſtances from the Sun, but that *Venus* is much bigger than *Mars.*

Having thus explain'd the two Schemes, there's no body I ſuppoſe but ſees, that in the firſt the Earth is made to be of the ſame ſort with the reſt of the Planets. For the very Poſition of the Circles ſhows it. And that the other Planets are round like it, and like it receive all the Light they have from the Sun, there's no room (ſince the Diſcoveries made by Teleſcopes) to doubt. Another thing they are like it in is, that they are moved round their own Axis; for ſince 'tis certain that *Jupiter* and *Saturn* are, who can doubt it of the others? Again, as the Earth has its Moon moving round it, ſo *Jupiter* and *Saturn* have theirs. Now ſince in ſo many things they thus agree, what can be more probable than that in others they agree too; and that the other Planets are as beautiful and as well ſtock'd with

The Earth juſtly liken'd to the Planets, and the Planets to it.

Book 1. Inhabitants as the Earth? or what ſhadow of Reaſon can there be why they ſhould not?

If any one ſhould be at the diſſection of a Dog, and be there ſhewn the Intrails, the Heart, Stomach, Liver, Lungs and Guts, all the Veins, Arteries and Nerves; could ſuch a Man reaſonably doubt whether there were the ſame Contexture and Variety of Parts in a Bullock, Hog, or any other Beaſt, tho he had never chanc'd to ſee the like opening of them? I don't believe he would. Or were we thorowly ſatisfy'd in the Nature of one of the Moons round *Jupiter*, ſhould not we ſtraight conclude the ſame of the reſt of them? So if we could be aſſur'd in but one Comet, what it was that is the cauſe of that ſtrange appearance, ſhould we not make that a Standard to judg of all others by? 'Tis therefore an Argument of no ſmall weight that is fetch'd from Relation and Likeneſs; and to reaſon from what we ſee and are ſure of, to what we cannot, is no falſe Logick. This muſt be our Method in this Treatiſe, where-

Arguments from their Similitude of no ſmall weight.

wherein from the Nature and Circumſtances of that Planet which we ſee before our eyes, we may gueſs at thoſe that are farther diſtant from us. Book 1.

The Planets are ſolid, and not without Gravity.

And, Firſt, 'tis more than probable that the Bodies of the Planets are ſolid like that of our Earth, and that they don't want what we call Gravity, that Virtue, which like a Loadſtone attracts whatſoever is near the Body to its Center. And that they have ſuch a Quality, their very Figure is a proof; for their Roundneſs proceeds only from an equal preſſure of all their Parts tending to the ſame Center. Nay more, we are ſo skilful now adays, as to be able to tell how much more or leſs the Gravitation in *Jupiter* or *Saturn* is than here; of which Diſcovery and its Author you may read my *Eſſay of the Cauſes of Gravitation.*

But now to carry the ſearch farther, let us ſee by what ſteps we muſt riſe to the attaining ſome knowlege in the more private Secrets concerning the State and Furniture of theſe new Earths. And, firſt, how likely is it

Book 1. that they may be ſtock'd with Plants and Animals as well as we? I ſuppoſe no body will deny but that there's ſomewhat more of Contrivance, ſomewhat more of Miracle in the production and growth of Plants and Animals, than in lifeleſs heaps of inanimate Bodies, be they never ſo much larger; as Mountains, Rocks, or Seas are. For the finger of God, and the Wiſdom of Divine Providence, is in them much more clearly manifeſted than in the other. One of *Democritus*'s or *Cartes*'s Scholars may venture perhaps to give ſome tolerable Explication of the appearances in Heaven and Earth, allow him but his Atoms and Motion; but when he comes to Plants and Animals, he'll find himſelf non-plus'd, and give you no likely account of their Production. For every thing in them is ſo exactly adapted to ſome deſign, every part of them ſo fitted to its proper uſe, that they manifeſt an Infinite Wiſdom, and exquiſite Knowlege in the Laws of Nature and Geometry, as, to omit thoſe Wonders in Generation, we ſhall by and by ſhow; and make

Have Animals and Planets.

make it an abſurdity even to think of their being thus haply jumbled together by a chance Motion of I don't know what little Particles. Now ſhould we allow the Planets nothing but vaſt Deſerts, lifeleſs and inanimate Stocks and Stones, and deprive them of all thoſe Creatures that more plainly ſpeak their Divine Architect, we ſhould ſink them below the Earth in Beauty and Dignity; a thing that no Reaſon will permit, as I ſaid before. Book 1.

Well then, now we have gain'd the Point for them, and the Planets may be allow'd ſome Bodys capable of moving themſelves, not at all inferior to ours, (for why ſhould they?) and theſe are Animals. Now for fear of ſtarving theſe poor Creatures, we muſt have Plants you know. And ſo the other Point is gain'd. And as for their Growth and Nouriſhment, 'tis no doubt the ſame with ours, ſeeing they have the ſame Sun to warm and enliven them as ours have. *Not to be imagin'd too unlike ours.*

But perhaps ſome body may ſay, we conclude too faſt. They will not deny indeed but that there may be

Book 1. Plants and Animals on the Surface of the Planets, that deſerve as well to be provided for by their Creator as ours do: but why muſt they be of the ſame nature with ours? Nature ſeems to court variety in her Works, and may have made them widely different from ours either in their matter or manner of Growth, in their outward Shape, or their inward Contexture; ſhe may have made them ſuch as neither our Underſtanding nor Imagination can conceive. That's the thing we ſhall now examin, and whether it be not more likely that ſhe has not obſerv'd ſuch a variety as they talk of. Nature ſeems moſt commonly, and in moſt of her Works, to affect Variety, 'tis true; But they ſhould conſider 'tis not the buſineſs of a man to pretend to ſettle how great this Difference and Variety muſt be. Nor does it follow, becauſe it may be Infinite, and out of our comprehenſion and reach, that therefore things in reality are ſo. For ſuppoſe God ſhould have pleaſed to have made all things there juſt as he has here, the Inhabitants of thoſe Places (if there

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are any ſuch ſtrange things) would admire his Wiſdom and Contrivance no leſs than if they were widely different; ſeeing they can't come to know what's done in the other Planets. Who doubts but that God, if he had pleaſed, might have made the Animals in *America* and other diſtant Countries nothing like ours? (and Nature you know affects Variety) yet we ſee he has not done it. They have indeed ſome difference in their ſhape, and 'tis fit they ſhould, to diſtinguiſh the Plants and Animals of thoſe Countries from ours, who live on this ſide the Earth; but even in this variety there is an Agreement, an exact Correſpondence in figure and ſhape, the ſame ways of Growth, and new Productions, and of continuing their own kind. Their Animals have Feet and Wings like ours, and like ours have Heart, Lungs, Guts, and the Parts ſerving to Generation; whereas all theſe things, as well with them as us, might, if it had ſo pleaſed Infinite Wiſdom, have been order'd a very different way. 'Tis plain then that Na-

Book 1.

Book 1. ture has not exhibited that Variety in her Works that ſhe could, and therefore we muſt not allow that weight to this Argument, as upon the account of it to make every thing in the Planets quite different from what is here. 'Tis more probable that all the difference there is between us and them, ſprings from the greater or leſs diſtance and influence from that Fountain of Heat and Life the Sun; which will cauſe a difference not ſo much in their Form and Shape, as in their Matter and Contexture.

Planets have Water.

And as for the matter whereof the Plants and Animals there conſiſt, tho it is impoſſible ever to come to the knowlege of its Nature, yet this we may venture to aſſert (there being ſcarce any doubt of it) that their Growth and Nouriſhment proceeds from ſome liquid Principle. For all Philoſophers agree that there can be no other way of Nutrition; ſome of the chief among them having made Water to be the Original of all things: For whatſoever's dry and without moiſture, is without motion too; and with-

without motion it's impoſſible there ſhould be any increaſe. But the parts of a Liquid being in continual motion one with another, and inſinuating and twiſting themſelves into the ſmalleſt Places, are thereby very proper and apt to add not themſelves only, but whatſoever elſe they may bring along with them to the increaſe and growth of Bodies. Thus we ſee that by the means of Water the Plants grow, bloſſom, and bear Fruit; and by the addition of that only, Stones grow together out of Sand. And there's no doubt but that Metals, Cryſtals, and Jewels, have the ſame method of Production: Tho in them there has been no opportunity to make the ſame obſervation, as well by reaſon of their ſlow advances, as that they are commonly found far from the Places of their Generation; thrown up I ſuppoſe by ſome Earthquakes or Convulſions. That the Planets are not without Water, is made not improbable by the late Obſervations: For about *Jupiter* are obſerv'd ſome ſpots of a darker hue than the reſt of his Body, which Book 1.

Book 1. which by their continual change ſhow themſelves to be Clouds: For the ſpots of *Jupiter* which belong to him, and never remove from him, are quite different from theſe, being ſometimes for a long time not to be ſeen for theſe Clouds; and again, when theſe diſappear, ſhowing themſelves. And at the going off of theſe Clouds, ſome ſpots have been taken notice of in him, much brighter than the reſt of his Body, which remain'd but a little while, and then were hid from our ſight. Theſe Monſieur *Caſſini* thinks are only the Reflection from the Snow that covers the tops of the Hills in *Jupiter*: but I ſhould rather think that it is only the colour of the Earth, which chances to be free from thoſe Clouds that commonly darken it.

Mars too is found not to be without his dark ſpots, by means of which he has been obſerv'd to turn round his own Axis in 24 hours and 40 minutes; the length of his day: but whether he has Clouds or no, we have not had the ſame opportunity of obſerving as in *Jupiter*, as well becauſe even when he

he is neareſt the Earth, he appears to us much leſs than *Jupiter*, as that his Light not coming ſo long a Journey, is ſo brisk as to be an Impediment to exact Obſervations: And this Reaſon is as much ſtronger in *Venus* as its Light is. But ſince 'tis certain that the Earth and *Jupiter* have their Water and Clouds, there is no reaſon why the other Planets ſhould be without them. I can't ſay that they are exactly of the ſame nature with our Water; but that they ſhould be liquid their uſe requires, as their beauty does that they ſhould be clear. For this Water of ours, in *Jupiter* or *Saturn*, would be frozen up inſtantly by reaſon of the vaſt diſtance of the Sun. Every Planet therefore muſt have its Waters of ſuch a temper, as to be proportion'd to its heat: *Jupiter*'s and *Saturn*'s muſt be of ſuch a nature as not to be liable to Froſt; and *Venus*'s and *Mercury*'s of ſuch, as not to be eaſily evaporated by the Sun. But in all of them, for a continual ſupply of Moiſture, whatever Water is drawn up by the Heat of the Sun into Vapors, muſt neceſſarily

Book I.

But not juſt like ours.

Book 1. rily return back again thither. And this it cannot do but in drops, which are cauſed as well there as with us, by their aſcending into a higher and colder Region of the Air, out of that which, by reaſon of the Reflection of the Rays of the Sun from the Earth, is warmer and more temperate.

Here then we have found in theſe new Worlds Fields warm'd by the kindly Heat of the Sun, and water'd with fruitful Dews and Showers: That there muſt be Plants in them as well for Ornament as Uſe, we have ſhewn juſt now. And what Nouriſhment, what manner of Growth ſhall we allow them? Why, I think there can be no better, nay no other, than what we here experience; by having their Roots faſtned into the Earth, and imbibing its nouriſhing Juices by their tender Fibres. And leſt they ſhould be only like ſo many bare Heaths, with nothing but creeping Shrubs and Buſhes, we'll e'en ſend them ſome nobler and loftier Plants, Trees, or ſomewhat like them: Theſe being the greateſt, and, except Waters, the only Orna-

Plants grow and are nouriſh'd there as they are here.

Ornament that Nature has beſtow'd upon the Earth. For not to ſpeak of thoſe many uſes that are made of their Wood, there's no one that is ignorant either of their Beauty or Pleaſantneſs. Now what way can any one imagine for a continual Production and Succeſſion of theſe Plants, but their bearing Seed? A Method ſo excellent that it's the only one that Nature has here made uſe of, and ſo wonderful, that it ſeems to be deſign'd not for this Earth alone. In fine, there's the ſame reaſon to think that this Method is obſerv'd in thoſe diſtant Countries, as there was of its being follow'd in the remote Quarters of this ſame Earth. Book 1.

The ſame true of their Animals.

'Tis much the ſame in Animals as 'tis in Plants, as to their manner of Nouriſhment, and Propagation of their kind. For ſince all the living Creatures of this Earth, whether Beaſts, Birds, Fiſhes, Worms, or Inſects, univerſally and inviolably follow the ſame conſtant and fixt Inſtitution of Nature; all feed on Herbs, or Fruits, or the Fleſh of other Animals that fed on

Book 1. on them: ſince all Generation is perform'd by the impregnating of the Eggs, and the Copulation of Male and Female: Why may not the ſame rule be obſerv'd in the Planetary Worlds? For *'tis certain that the Herbs and Animals that are there would be loſt, their whole Species deſtroy'd without ſome daily new Productions:* except there be no ſuch thing there as Misfortune or Accident: except the Plants are not like other humid Bodies, but can bear Heat, Froſt and Age, without being dry'd up, kill'd, or decay'd: except the Animals have Bodies as hard and durable as Marble; which I think are groſs Abſurdities. If we ſhould invent ſome new way for their coming into the World, and make them drop like Soland Geeſe from Trees, how ridiculous would this be to any one that conſiders the vaſt difference between Wood and Fleſh? Or ſuppoſe we ſhould have new ones made every day out of ſome ſuch fruitful Mud as that of *Nile*, who does not ſee how contrary this is to all that's reaſonable? And that 'tis much more agreeable to the

the Wiſdom of God, once for all to create of all ſorts of Animals, and diſtribute them all over the Earth in ſuch a wonderful and inconceivable way as he has, than to be continually obliged to new Productions out of the Earth? And what miſerable, what helpleſs Creatures muſt theſe be, when there's no one that by his duty will be obliged, or by that ſtrange natural fondneſs, which God has wiſely made a neceſſary argument for all Animals to take care of their own, will be moved to aſſiſt, nurſe or educate them? Book 1.

As for what I have ſaid concerning their Propagation, I cannot be ſo poſitive; but the other thing, namely, that they have Plants and Animals, I think I have fully proved. And by the ſame Argument, of their not being inferiour to our Earth, they muſt have as great a variety of both as we have. What this is, will be beſt known to him that conſiders the different ways our Animals make uſe of in moving from one place to another. Which may be reduc'd, I think, to theſe; either

Book 1. ther that they walk upon two feet or four; or like Inſects, upon ſix, nay ſometimes hundreds; or that they fly in the Air bearing up, and wonderfully ſteering themſelves with their Wings; or creep upon the Ground without feet; or by a violent Spring in their Bodies, or paddling with their feet, cut themſelves away in the Waters. I don't believe, nor can I conceive, that there ſhould be any other way than theſe mention'd. The Animals then in the Planets muſt make uſe of one or more of theſe, like our amphibious Birds, which can ſwim in Water as well as walk on Land, or fly in the Air; or like our Crocodiles and Sea-Horſes, muſt be Mongrels, between Land and Water. There can no other method be imagin'd but one of theſe. For where is it poſſible for Animals to live, except upon ſuch a ſolid Body as our Earth, or a fluid one like the Water, or ſtill a more fluid one than that, ſuch as our Air is? The Air I confeſs may be much thicker and heavier than ours, and ſo, without any diſadvantage to its Tranſparency;

rency, be fitter for the volatile Ani- Book 1.
mals. There may be too many ſorts of Fluids ranged over one another in rows as it were. The Sea perhaps may have ſuch a fluid lying on it, which tho ten times lighter than Water, may be a hundred times heavier than Air; whoſe utmoſt Extent may not be ſo large as to cover the higher places of their Earth. But there's no reaſon to ſuſpect or allow them this, ſince we have no ſuch thing; and if we did, it would be of no advantage to them, for that the former ways of moving would not be hereby at all increas'd: But when we come to meddle with the Shape of theſe Creatures, and conſider the incredible variety that is even in thoſe of the different parts of this Earth, and that *America* has ſome which are no where elſe to be found, I muſt then confeſs that I think it beyond the force of Imagination to arrive at any knowlege in the matter, or reach probability concerning the figures of theſe Planetary Animals. Altho conſidering theſe ways of Motion we e'en now recounted,

Book 1. they may perhaps be no more different from ours than ours (thoſe of ours I mean that are moſt unlike) are from one another.

If a man were admitted to a Survey of *Jupiter* or *Venus*, he would no doubt find as great a number and variety as he had at home. Let us then, that we may make as near a gueſs at, and as reaſonable a judgment of the matter as we can, conſider the many ſorts, and the admirable difference in the ſhapes of our own Animals; running over ſome of the chief of them (for 'twould be tedious to ſet about a general Catalogue) that are notoriouſly different from one another, either in their Figure or ſome peculiar Property belonging to them; as they belong to the Land, or the Water, or the Air. Among the Beaſts we may take notice of the great diſtance between the Horſe, the Elephant, the Lion, the Stag, the Camel, the Hog, the Ape, the Porcupine, the Tortoiſe, the Cameleon: in the Water, of that between the Whale, and the Sea-Calf, the Skait, the Pike, the Eel, the Ink-Fiſh,

Great variety of Animals in this Earth.

Fiſh, the Pourcontrel, the Crocodile, the flying Fiſh, the Cramp Fiſh, the Crab, the Oiſter, and the Purple Fiſh: and among Birds, of that between the Eagle, the Oſtrich, the Peacock, the Swan, the Owl, and the Bat: and in Inſects, of that between the Ants, the Spider, the Fly, and the Butterfly; and of that Prodigy in their wonderful change from Worms. In this Roll I have paſs'd by the creeping kind as one ſort, and skip'd over that vaſt multitude of leſs different Animals that fill the intermediate ſpaces. But be they never ſo many, there is no reaſon to think that the Planets cannot match them. For tho we in vain gueſs at the Figures of thoſe Creatures, yet we have diſcover'd ſomewhat of their manner of Life in general; and of their Senſes we ſhall more by and by. *And no leſs in the Planets.*

The more conſiderable Differences in our Plants ought to be thought on, as well as the other. As in Trees, that between the Fir and the Oak, the Palm, the Vine, the Fig, and the Co-co-Nut Tree, and that in the *Indies*, from whoſe Boughs new Roots ſpring, *The ſame in Plants.*

Book 1. and grow downwards into the Earth. In Herbs, the difference is notable between Grafs, Poppy, Colewort, Ivy, Pompions, and the Indian Fig with thick Leaves growing up without any Stalk, and Aloe. Between every one of which again there are many leſs differing Plants not taken notice of. Then the different ways of raiſing them are remarkable, whether from Seeds, or Kernels, or Roots, or by grafting or inoculating them. And yet in all theſe, whether we conſider the things themſelves, or the ways of their Production, I make no doubt but that the Planetary Worlds have as wonderful a variety as we.

Rational Animals in the Planets.

But ſtill the main and moſt diverting Point of the Enquiry is behind, which is the placing ſome Spectators in theſe new Diſcoveries, to enjoy theſe Creatures we have planted them with, and to admire their Beauty and Variety. And among all, that have never ſo flightly meddled with theſe matters, I don't find any that have ſcrupled to allow them their Inhabitants: not Men perhaps like ours, but ſome

ſome Creatures or other endued with Reaſon. For all this Furniture and Beauty the Planets are ſtock'd with ſeem to have been made in vain, without any deſign or end, unleſs there were ſome in them that might at the ſame time enjoy the Fruits, and adore the wiſe Creator of them. But this alone would be no prevailing Argument with me to allow them ſuch Creatures. For what if we ſhould ſay, that God made them for no other deſign, but that he himſelf might ſee (not as we do 'tis true; but that he that made the Eye ſees, who can doubt?) and delight himſelf in the contemplation of them? For was not Man himſelf, and all that the whole World contains, made upon this very account? That which makes me of this opinion, that thoſe Worlds are not without ſuch a Creature endued with Reaſon, is, that otherwiſe our Earth would have too much the advantage of them, in being the only part of the Univerſe that could boaſt of ſuch a Creature ſo far above, not only Plants and Trees, but all

Book 1.

Book 1. Animals whatſoever: a Creature that has a Divine ſomewhat within him, that knows, and underſtands, and remembers ſuch an innumerable number of things; that deliberates, weighs and judges of the Truth: a Creature upon whoſe account, and for whoſe uſe, whatſoever the Earth brings forth ſeems to be provided. For every thing here he converts to his own ends. With the Trees, Stones, and Metals, he builds himſelf Houſes: the Birds and Fiſhes he ſuſtains himſelf with: and the Water and Winds he makes ſubſervient to his Navigation; as he doth the ſweet Smell and glorious Colours of the Flowers to his Delight. What can there be in the Planets that can make up for its Defects in the want of ſo noble an Animal? If we ſhould allow *Jupiter* a greater variety of other Creatures, more Trees, Herbs and Metals, all theſe would not advantage or dignify that Planet ſo much as that one Animal doth ours by the admirable Productions of his penetrating Wit. If I am out in this, I do not know when

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to truſt my Reaſon, and muſt allow my ſelf to be but a poor Judg in the true eſtimate of things. Book 1.

Vices of Men no hindrance to their being the Glory of the Planet they inhabit.

Not let any one ſay here, that there's ſo much Villany and Wickedneſs in this Man that we have thus magnified, that it's a reaſonable doubt, whether he would not be ſo far from being the Glory and Ornament of the Planet that enjoys his Company, that he would be rather its Shame and Diſgrace. For firſt, the Vices that moſt Men are tainted with, are no hindrance, but that thoſe that follow the Dictates of true Reaſon, and obey the Rules of a rigid Virtue, are ſtill a Beauty and Ornament to the place that has the happineſs to harbour them. Beſides, the Vices of Men themſelves are of excellent uſe, and are not permitted and allow'd in the World without wiſe deſign. For ſince it has ſo pleaſed God to order the Earth, and every thing in it as we ſee it is (for it's nonſenſe to ſay it happen'd againſt his Will or Knowlege) we muſt not think that thoſe different Opinions, and that various multiplicity of Minds

Book 1. were plac'd in different Men to no end or purpoſe: but that this mixture of bad Men with good, and the Conſequents of ſuch a mixture, as Misfortunes, Wars, Afflictions, Poverty, and the like, were given us for this very good end, *viz.* the exerciſing our Wits, and ſharpening our Inventions; by forcing us to provide for our own neceſſary defence againſt our Enemies. 'Tis to the fear of Poverty and Miſery that we are beholden for all our Arts, and for that natural Knowlege which was the product of laborious Induſtry; and which makes us that we cannot but admire the Power and Wiſdom of the Creator, which otherwiſe we might have paſs'd by with the ſame indifference as Beaſts. And if Men were to lead their whole Lives in an undiſturb'd continual Peace, in no fear of Poverty, no danger of War, I don't doubt they would live little better than Brutes, without all knowlege or enjoyment of thoſe Advantages that make our Lives paſs on with pleaſure and profit. We ſhould want the wonderful Art of Writing, if its great

uſe

uſe and neceſſity in Commerce and War had not forc'd out the Invention. 'Tis to theſe we owe our Art of Sailing, our Art of Sowing, and moſt of thoſe Diſcoveries of which we are Maſters; and almoſt all the Secrets in experimental Knowlege. So that thoſe very things that make up their Indictment againſt Reaſon, are no ſmall helps to its advancement and perfection. For thoſe Virtues themſelves, Fortitude and Conſtancy, would be of no uſe if there were no Dangers, no Adverſity, no Afflictions for their exerciſe and trial. Book 1.

If we ſhould therefore imagine in the Planets ſome ſuch reaſonable Animal as Man is, adorn'd with the ſame Virtues, and infected with the ſame Vices, it would be ſo far from degrading or vilifying them, that while they want ſuch a one, I muſt think them inferior to our Earth.

Well, but allowing theſe Planetarians ſome ſort of Reaſon, muſt it needs be the ſame with ours? Why truly I think 'tis, and muſt be ſo; whether we conſider it as applied to Juſtice and Mora- *Reaſon there not different from what 'tis here.*

Book 1. Morality, or exerciſed in the Principles and Foundations of Science. For Reaſon with us is that which gives us a true ſenſe of Juſtice and Honeſty, Praiſe, Kindneſs and Gratitude: 'tis that that teaches us to diſtinguiſh univerſally between Good and Bad; and renders us capable of Knowlege and Experience in it. And can there be any where a Reaſon contrary to this? or can what we call juſt and generous in *Jupiter* or *Mars* be thought unjuſt Villany? This is not at all, I don't ſay probable, but poſſible. For the aim and deſign of the Creator is every where the preſervation and ſafety of his Creatures. Now when ſuch a Reaſon as we are maſters of, is neceſſary for the preſervation of Life, and promoting of Society (a thing that they be not without, as we ſhall ſhow) would it not be ſtrange that the Planetarians ſhould have ſuch a perverſe ſort of Reaſon given them, as would neceſſarily deſtroy and confound what it was deſign'd to maintain and defend? But allowing Morality and Paſſions with thoſe Gentlemen to be ſomewhat diffe-

different from ours, and ſuppoſing they may act by other principles in what belongs to Friendſhip, and Anger, Hatred, Honeſty, Modeſty, and Comelineſs, yet ſtill there would be no doubt, but that in the ſearch after Truth, in judging of the Conſequences of things, in reaſoning, particularly in that ſort which belongs to Magnitude or Quantity, about which their Geometry (if they have ſuch a thing) is employ'd, there would be no doubt I ſay, but that their Reaſon here muſt be exactly the ſame, and go the ſame way to work with ours, and that what's true in one part will hold true over the whole Univerſe; ſo that all the difference muſt lie in the degrees of Knowlege, which will be proportional to the Genius and Capacity of the Inhabitants. Book 1.

They have Senſes.

But I perceive I am got a little too far: For till I have furniſhed them with Senſes, neither will Life be any pleaſure to them, nor Reaſon of any uſe. And I think it very probable, that all their Animals, as well their Beaſts as rational Creatures, are like ours

Book 1. ours in all that relates to the Senſes: For without the power of Seeing we ſhould find it impoſſible for Animals to provide Food for themſelves, or be forewarn'd of any approaching danger, ſo as to guard themſelves from it. So that where-ever we plant any Animals, except we would have them lead the Life of Worms or Moles, we muſt allow them Sight; than which nothing can conduce more either to the preſervation or pleaſure of their Lives. Then if we conſider the wonderful nature of Light, and the amazing Artifice in the fit framing the eye for the reception of it, we cannot but ſee that Bodies ſo vaſtly remote could not be view'd by us in their proper Figures and juſt Diſtances, any other way than by Sight. For this Senſe, and all others that we know of, muſt proceed from an external Motion. Which in the ſenſe of Seeing muſt come either from the Sun, the fixt Stars, or Fire: whoſe Particles being whirled about with a rapid Motion, communicate it to the Celeſtial Matter about, whence 'tis convey'd in an inſtant to the moſt diſtant

Sight.

distant parts, just like Sound through the Air. If it were not for this Motion of the intermediate Matter, we should be all in darkness, and have sight neither of Sun nor Stars, nor any thing else, for all other Light must come to us at second-hand from them. This Motion perceived by the Eyes is called Light. And the nice Curiosity of this Perception is admirable, in that it is caused by the smallest Particle of that fine Matter, and can at the same time determine the Coast from whence the Motion comes; in that all these different Roads of Motion, these Waves crossing and interfering with one another, are yet no hindrance to every ones free passage. All these things are so wisely, so wonderfully contrived, that it's above the power of humane Wit, not to invent or frame somewhat like them, but even to imagine and comprehend them. For what can be more amazing, than that a Particle of Body should be so devised and framed, as by its means to show us the Shape, the Position, the Distance, and all the Motions, nay and all the Colours,

Book 1. Colours, diſtinguiſhing of a Body that is far remote from us? And then the artful Compoſition of the Eye, drawing an exact Picture of the Objects without it, upon the concave ſide of the Choroides, is even above all admiration, nor is there any thing in which God has more plainly manifeſted his excellent Geometry. And theſe things are not only contrived and framed with ſo great Wiſdom and Skill, as not to admit of better, but to any one that conſiders them attentively, they ſeem to be of ſuch a nature as not to allow any other Method. For it's impoſſible that Light ſhould repreſent Objects to us at ſo vaſt a diſtance, except by ſuch an intervening Motion; and it's as impoſſible that any other Compoſition of the Eye ſhould be equally fitted to the reception of ſuch Impreſſions. So that I cannot but think them mightily out, that maintain theſe things might have been contrived many other ways. It's likely then, and credible, that in theſe things the Planets have an exact correſpondence with us, and that their Animals have

have the ſame Organs, and uſe the ſame way of ſight that we do. Well then they have Eyes, and two at leaſt we muſt grant them, otherwiſe they would not perceive ſome things cloſe to them, and ſo could not avoid Miſchiefs that take them on the blind ſide. And if we muſt allow them all Animals for the preſervation of their Life, how much more muſt they that make more, and more noble uſes of them, not be deprived of the Bleſſing of ſo advantageous Members? For by them we view the various Flowers, and the elegant Features of Beauty: with them we read, we write, we contemplate the Heavens and Stars, and meaſure their Diſtances, Magnitudes, and Journeys: which how far they are common to the Inhabitants of thoſe Worlds with us, I ſhall ſtrait examine. But firſt I ſhall enquire whether now we have given them one, we may not venture upon the other four Senſes, to make them as good Men as our ſelves. And truly Hearing puts in hard, and almoſt perſwades me to give it a ſhare in the Animals of thoſe new Countries. *Hearing.*

Book 1. tries. And 'tis of great conſequence in defending us from ſudden accidents; and, eſpecially when Seeing is of no uſe to us, it ſupplys its place, and gives us ſeaſonable warning of any imminent danger. Beſides, we ſee many Animals call their fellows to them with their Voice, which Language may have more in it than we are aware of, tho we don't underſtand it. But if we do but conſider the vaſt uſes and neceſſary occaſions of Speaking on the one ſide, and Hearing on the other, among thoſe Creatures that make uſe of their Reaſon, it will ſcarce ſeem credible that two ſuch uſeful, ſuch excellent things were deſigned only for us. For how is it poſſible but that they that are without theſe, muſt be without many other Neceſſaries and Conveniences of Life? Or what can they have to recompenſe this want? Then, if we go ſtill farther, and do but meditate upon the neat and frugal Contrivance of Nature in making this ſame Air, by the drawing in of which we live, by whoſe Motion we ſail, and by whoſe means Birds fly, for a con-

conveyance of Sound to our ears; and this Sound for the conveyance of another man's Thoughts to our Minds: can we ever imagin that ſhe has left thoſe other Worlds deſtitute of ſo vaſt Advantages? That they don't want the means of them is certain, for their having Clouds in *Jupiter* puts it paſt doubt that they have Air too; that being moſtly formed of the Particles of Water flying about, as the Clouds are of them gathered into ſmall Drops. And another proof of it is, the neceſſity of breathing for the preſervation of Life, a thing that ſeems to be as univerſal a Dictate of Nature, as feeding upon the Fruits of the Earth. Book I.

A Medium to convey Sound to the Ear.

As for Feeling, it ſeems to be given upon neceſſity to all Creatures that are cover'd with a fine and ſenſible Skin, as a Caution againſt coming too near thoſe things that may injure or incommode them: and without it they would be liable to continual Wounds, Blows and Bruiſes. Nature ſeems to have been ſo ſenſible of this, that ſhe has not left the leaſt place free from ſuch a perception. Therefore it's pro-

Touch.

Book 1. bable that the Inhabitants of thoſe Worlds are not without ſo neceſſary a Defence, and ſo fit a Preſervative againſt Dangers and Miſhaps.

Smell and Taſt. And who is there that doth not ſee the inevitable neceſſity for all Creatures that live by feeding to have both Taſt and Smell, that they may diſtinguiſh thoſe things that are good and nouriſhing, from thoſe that are miſchievous and harmful? If therefore we allow the Planetary Creatures to feed upon Herbs, Seeds, or Fleſh, we muſt allow them a diſtinguiſhing Taſt and Smell too, that they may chuſe or refuſe any thing according as they find it likely to be advantagious or noxious to them.

I know that it hath been a queſtion with many, whether there might not have been more Senſes than thoſe five. If we ſhould allow this, it might nevertheleſs be reaſonably doubted, whether the Senſes of the Planetary Inhabitants are much different from ours. I muſt confeſs, I cannot deny but there might poſſibly have been more Senſes; but when I conſider the Uſes

Their Senſes not very different from ours.

of

of thoſe we have, I cannot think but they would have been ſuperfluous. The Eye was made to diſcern near and remote Objects, the Ear to give us notice of what our Eyes could not, either in the dark or behind our back: Then what neither the Eye nor the Ear could, the Noſe was made (which in Dogs is wonderfully nice) to warn us of. And what eſcapes the notice of the other four Senſes, we have Feeling to inform us of the too near approaches of, before it can do us any miſchief. Thus has Nature ſo plentifully, ſo perfectly provided for the neceſſary preſervation of her Creatures here, that I think ſhe can give nothing more to thoſe there, but what will be needleſs and ſuperfluous. Yet the Senſes were not wholly deſign'd for uſe: but Men from all, and all other Animals from ſome of them, reap Pleaſure as well as Profit, as from the Taſt in delicious Meats; from the Smell in Flowers and Perfumes; from the Sight in the contemplation of beauteous Shapes and Colours; from the Hearing in the ſweetneſs and har-

Book 1.

Book 1. mony of Sounds; from the Feeling in Venery, unleſs you pleaſe to count that for a particular Senſe by it ſelf. Since it is thus, I think 'tis but reaſonable to allow the Inhabitants of the Planets theſe ſame advantages that we have from them. For upon this conſideration only, how much happier and eaſier a man's Life is render'd by the enjoyment of them, we muſt be obliged to grant them theſe Bleſſings, except we would ingroſs every thing that is good to our ſelves, as if we were worthier and more deſerving than any elſe. But moreover, that Pleaſure which we perceive in eating or in copulation, ſeems to be a neceſſary and provident Command of Nature, whereby it tacitly compels us to the preſervation and continuance of our Life and Kind. It is the ſame in Beaſts. So that both for their happineſs and preſervation it's very probable the reſt of the Planets are not without it. Certainly when I conſider all theſe things, how great, noble, and uſeful they are; when I conſider what an admirable Providence it is that

They have Pleaſure ariſing from the Senſes.

that there's ſuch a thing as Pleaſure in the World, I can't but think that our Earth, the ſmalleſt part almoſt of the Univerſe, was never deſign'd to monopolize ſo great a Bleſſing. And thus much for thoſe Pleaſures which affect our bodily Senſes, but have little or no relation to our Reaſon and Mind. But there are other Pleaſures which Men enjoy, which their Soul only and Reaſon can reliſh: ſome airy and brisk, others grave and ſolid, and yet nevertheleſs Pleaſures, as ariſing from the Satisfaction which we feel in Knowlege and Inventions, and ſearches after Truth, of which whether the Planetary Inhabitants are not partakers, we ſhall have an opportunity of enquiring by and by. Book 1.

There are ſome other things to be conſider'd firſt, in which it's probable they have ſome relation to us. That the Planets have thoſe Elements of Earth, Air, and Water, as well as we, I have already made not unlikely. Let us now ſee whether they may not have Fire too: which is not ſo properly call'd an Element, as a rapid

Book 1. Motion of the Particles in the inflammable Body. But be it what it will, there are many Arguments for their not being without it. For this Earth is not ſo truly call'd the Place of Fire as the Sun: and as by the heat of that all Plants and Animals here thrive and live; ſo, no doubt, is it in the other Planets. Since then Fire is cauſed by a moſt intenſe and vigorous Heat, it follows that the Planets, eſpecially thoſe nearer the Fountain of it, have their proportionate degrees of Heat and Fire. And when there are ſo many ways of its Production, as by the collection of the Rays of the Sun, by the reflection of Mirrors, by the ſtriking of Flint and Steel, by the rubbing of Wood, by the cloſe loading of moiſt Graſs, by Lightning, by the eruptions of Mountains and Volcanos, it's ſtrange if neither Art ſhould have produc'd it, nor Nature effected it there by one of theſe many means. Then how uſeful and neceſſary is it to us? By it we drive away Cold, and ſupply the want of the Sun in thoſe Countries where his oblique Rays make

All the Planets have Fire.

make a leſs vigorous Impreſſion, and Book 1.
ſo keep a great part of the Earth from being an uninhabited Deſart: which is equally neceſſary in all the Planets, whether we allow them Succeſſion of Seaſons, or a perpetual Spring and Æquinox: for even then the Countries near the Pole would receive but little advantage from the Heat of the Sun. By the help of this we turn the night into day, and thereby make a conſiderable addition to the ſhortneſs ſo our Lives. Upon all theſe accounts I muſt not let this Earth of ours enjoy it all alone, and exclude all the other Planets from ſo advantageous and ſo profitable a Gift.

But perhaps it may be asked as well concerning Brutes as rational Creatures, and of their Plants and Trees too, whether they are proportionably larger or leſs than ours. For if the Magnitude of the Planets was to be the Standard of their meaſure, there would be Animals in *Jupiter* ten or fifteen times larger than Elephants, and as much longer than our Whales. And then their Men muſt be mere *Goliahs*,

The bigneſs of their Creatures not rightly gueſt at by the bigneſs of the Planets.

Book 1. in reſpect of our Pygmiſhips. Now tho I don't ſee any ſo great abſurdity in this as to make it impoſſible, yet there is no reaſon to think it is really ſo, ſeeing Nature has not always ty'd her ſelf to thoſe Rules which we have thought more convenient for her: for example, the magnitude of the Planets is not anſwerable to their diſtances from the Sun; but *Mars*, tho more remote, is far leſs than *Venus*: and *Jupiter* turns round his Axis in ten hours, when the Earth which is much leſs than him, ſpends 24. But ſince Nature, perhaps ſome body will ſay, has not obſerv'd ſuch a Regularity in the proportion of things, for ought we know we may have a Race of Pygmies about the bigneſs of Frogs and Mice, poſſeſs'd of the Planets. But I ſhall ſhow that this is very improbable by and by.

In the Planets are many ſorts of rational Creatures as well as here.

There may ariſe another Queſtion, whether there be in the Planets but one or more ſorts of rational Creatures poſſeſs'd of different degrees of Reaſon and Senſe. There is ſomething not unlike this to be obſerv'd among

us,

us. For to paſs by thoſe who have human Shape (altho ſome of them would very well bear that enquiry too) if we do but conſider ſome ſorts of Beaſts, as the Dog, the Ape, the Beaver, the Elephant, nay ſome Birds and Bees, what Senſe and Underſtanding they are maſters of, we ſhall be forc'd to allow, that Man is not the only rational Animal. For we diſcover ſomewhat in them of Reaſon independent on, and prior to all teaching and practice. Book 1.

But ſtill no body can doubt, but that the Underſtanding and Reaſon of Man is to be prefer'd to theirs as being comprehenſive of innumerable things, indued with an infinite memory of what's paſt, and capable of providing againſt what's to come. That there is ſome ſuch rational Creature in the other Planets, which is the Head and Sovereign of the reſt, is very reaſonable to believe: for otherwiſe, were many endued with the ſame Wiſdom and Cunning, we ſhould have them always doing miſchief, always quarrelling and fighting one another for

Book 1. for Empire and Sovereignty, a thing that we feel too much of where we have but one ſuch Creature. But to let that paſs, our next Enquiry ſhall be concerning thoſe Animals in the Planets which are furniſh'd with the greateſt Reaſon, whether it's poſſible to know wherein they employ it, and whether they have made as great advances in Arts and Knowlege as we in our Planet. Which deſerves moſt to be conſider'd and examin'd of any thing belonging to their nature; and for the better performance of it we muſt take our riſe ſomewhat higher, and nicely view the Lives and Studies of Men.

And in thoſe things wherein Men provide and take care only of what's abſolutely neceſſary for the preſervation of their Life; in defending themſelves from the Injuries of the Air; in ſecuring themſelves againſt the Incurſions of Enemies by Walls; and againſt Fraud and Diſturbances by Laws; in educating their Children, and providing for themſelves and them: In all theſe I can ſee no great reaſon

reaſon that Man has to boaſt of the preeminency of his Reaſon above Beaſts and other Animals. For moſt of theſe things they perform with greater eaſe and art than us, and ſome of them they have no need of. For that ſenſe of Virtue and Juſtice in which Man excels, of Friendſhip, Gratitude and Honeſty, of what uſe are they, but either to put a ſtop to the Wickedneſs of Men, or to ſecure us from mutual Aſſaults and Injuries, a thing wherein the Beaſts want no Guide but Nature and Inclination? Then if we ſet before our eyes the manifold Cares, the diſturbances of Mind, the reſtleſs Deſires, the dread of Death, that are the reſult of this our Reaſon; and compare them with that eaſy, quiet, and harmleſs Life which other Animals enjoy, we ſhould be apt to wiſh a change, and conclude that they, eſpecially Birds, liv'd with more pleaſure and happineſs than Man could with all his Wiſdom. For they have as great a guſto of bodily Pleaſures as we, let the new Philoſophers ſay what they will, who would have

Book 1. have them go for nothing but Clocks and Engines of Fleſh; a thing which Beaſts ſo plainly confute by crying and running away from a ſtick, and all other actions, that I wonder how any one could ſubſcribe to ſo abſurd and cruel an Opinion. Nay I can ſcarce doubt but that Birds feel no ſmall pleaſure in their eaſy, ſmooth ſailing through the Air; and would much more if they but knew the advantages it hath above our ſlow and laborious Progreſſion. What is it then after all that ſets human Reaſon above all other, and makes us preferable to the reſt of the Animal World? Nothing in my mind ſo much as the contemplation of the Works of God, and the ſtudy of Nature, and the improving thoſe Sciences which may bring us to ſome knowlege in their Beauty and Variety. For without Knowlege what would be Contemplation? And what difference is there between a Man, who with a careleſs ſupine negligence views the Beauty and Uſe of the Sun, and the fine golden Furniture of the Heaven, and one who

Men chiefly differ from Beaſts in the ſtudy of Nature.

who with a learned Niceneſs ſearches into their Courſes; who underſtands wherein the Fixt Stars, as they are call'd, differ from the Planets, and what is the reaſon of the regular Viciſſitude of the Seaſons; who by ſound reaſoning can meaſure the magnitude and diſtance of the Sun and Planets? Or between ſuch a one as admires perhaps the nimble Activity and ſtrange Motions of ſome Animals, and one that knows their whole Structure, underſtands the whole Fabrick and Architecture of their Compoſition? If therefore the Principle we before laid down be true, that the other Planets are not inferior in dignity to ours, what follows but that they have Creatures not to ſtare and wonder at the Works of Nature only, but who employ their Reaſon in the examination and knowlege of them, and have made as great advances therein as we have? They do not only view the Stars, but they improve the Science of Aſtronomy: nor is there any thing can make us think this improbable, but that fond conceitedneſs of every thing that we call

Book 1.

They have Aſtronomy.

Book 1. call our own, and that pride that is too natural to us to be eaſily laid down. But I know ſome will ſay, we are a little too bold in theſe Aſſertions of the Planets, and that we mounted hither by many Probabilities, one of which, if it chance to be falſe, and contrary to our ſuppoſition, would, like a bad Foundation, ruin the whole Building, and make it fall to the ground. But I would have them to know, that all I have ſaid of their Knowlege in Aſtronomy, has proofs enough, antecedent to thoſe we now produc'd. For ſuppoſing the Earth, as we did, one of the Planets of equal dignity and honor with the reſt, who would venture to ſay, that no where elſe were to be found any that enjoy'd the glorious ſight of Nature's Opera? Or if there were any fellow-Spectators, yet we were the only ones that had dived deep into the ſecrets and knowlege of it? So then here's a proof not ſo far fetch'd for the Aſtronomy of the Planets, the ſame which we uſed for their having rational Creatures, and enjoying the other advantages

tages we before talk'd of, which ſerves at the ſame time for the confirmation of our former Conjectures. But if Amazement and Fear at the Eclipſes of the Moon and Sun gave the firſt occaſion to the ſtudy of Aſtronomy, as they ſay it did, then it's almoſt impoſſible that *Jupiter* and *Saturn* ſhould be without it; the Argument being of much greater force in them, by reaſon of the daily Eclipſes of their Moons, and the frequent ones of the Sun to their Inhabitants. So that if a Perſon diſintereſted in his Judgment, and equally ignorant of the Affairs of all the Planets, were to give his Opinion in the matter, I don't doubt he would give the cauſe for Aſtronomy to thoſe two Planets rather than us. Book 1.

This ſuppoſition of their Knowlege and Uſe of Aſtronomy in the Planetary Worlds, will afford us many new Conjectures about their manner of life, and their ſtate as to other things.

And all its ſubſervient Arts.

For, Firſt: No Obſervations of the Stars that are neceſſary to the knowlege of their Motions, can be made without Inſtruments; nor can theſe

Book I. theſe be made without Metal, Wood, or ſome ſuch ſolid Body. Here's a neceſſity of allowing them the Carpenters Tools, the Saw, the Ax, the Plane, the Mallet, the File: and the making of theſe requires the uſe of Iron, or ſome equally hard Metal.

Geometry and Arithmetick: Again, theſe Inſtruments can't be without a Circle divided into equal Parts, or a ſtreight Line into unequal. Here's a neceſſity for introducing Geometry and Arithmetick. Then the

And Writing. neceſſity in ſuch Obſervations of marking down the Epochas or Accounts of Time, and of tranſmitting them to Poſterity, will force us to grant them the Art of Writing; I won't ſay the ſame with ours which is commonly uſed, but I dare affirm not more ingenious or eaſy. For how much more ready and expeditious is our way, than by that multitude of Characters uſed in *China*; and how vaſtly preferable to Knots tied in Cords, or the Pictures in uſe among the barbarous People of *Mexico* and *Peru*? There's no Nation in the World but has ſome way or other of writing and marking down

their

their Thoughts: So that it's no wonder if the Planetarians have been taught it by that great School-mistress Necessity, and apply it to the study of Astronomy and other Sciences. In Astronomical matters the necessity of it is moreover apparent from hence, that the motion of the Stars is as 'twere to be fancied and gues's'd at in different Systems, and these Systems to be continually improved and corrected, as later and more exact Observations shall convince the old ones of faults: all which can never be deliver'd down to succeeding Generations, unless we make use of Letters and Figures. Book I.

But for all our large and liberal allowances to these Gentlemen, they will still be behind-hand with us. For we have so certain a knowlege of the true System and Frame of the Universe; we have so admirable an Invention of Telescopes to help our failing Eye-sight in the view of the bigness and different forms of the Planetary Bodies, in the discovery of the Mountains, and the Shadows of them on *And Opticks.*

Book 1. the Surface of the Moon, in the bringing to light an innumerable multitude of Stars otherwiſe inviſible, that we muſt neceſſarily be far their Maſters in that Knowlege. What muſt I do here? I could find in my heart (and I can ſee no reaſon why I may not, except it be to flatter and complement our ſelves in being the only People that have the advantage of ſuch excellent Inventions) either to allow theſe Planetary Inhabitants ſuch ſharp Eyes as not to need them, or elſe the uſe of Glaſſes to help the deficiency of their Sight. And yet I dare not, for fear People ſhould be ſo diſturbed at the ridiculous Extravagancy of ſuch an Opinion, as to take the meaſure of my other Conjectures by it, and hiſs them all off, upon the account of this alone.

Theſe Sciences not contrary to Nature.

But ſome body may perhaps object, and that not without reaſon at firſt ſight, that the Planetarians it's likely are deſtitute of all refined Knowlege, juſt as the Americans were before they had Commerce with the Europeans. For if one conſiders the Ignorance of

thoſe Nations, and of others in *Aſia* and *Africa* equally barbarous, it will appear as if the main deſign of the Creator in placing Men upon the Earth was that they might live, and, in a juſt ſenſe of all the Bleſſings and Pleaſure they enjoy, worſhip the Fountain of their Happineſs; but that ſome bold fellows have leapt over the bounds of Nature, and made ſearches into thoſe forbidden depths only out of an affectation of knowing more than they were made for. There does not want an Anſwer for theſe Men. For God could not but foreſee the advances Men would make, in their enquiring into the Affairs of Heaven: that they would diſcover Arts uſeful and advantageous to Life: that they would croſs the Seas, and dig up the Bowels of the Earth. Nothing of all this could happen contrary to the Mind and Knowlege of the Infinite Author of all things. And if he foreſaw theſe things would be, he ſo appointed and deſtin'd them to human kind. And the Studies of Arts and Sciences cannot be ſaid to be con- Book 1.

Book 1. trary to Nature, ſince in the ſearch thereof they are employ'd: eſpecially if we conſider the natural deſire and love of Knowlege, rooted in all men. For it's impoſſible this ſhould have been given them upon no deſign or account. But they will urge, that if ſuch a Knowlege is natural, if we were born for it, why are there ſo very few, eſpecially in Aſtronomy, that proſecute theſe Studies? For *Europe* is the only Quarter of the Earth in which there have been any advancements made in Aſtronomy. And as for the Judicial Aſtrology, that pretends to foretel what is to come, it is ſuch a ridiculous, and oftentimes miſchievous Folly, that I do not think it fit to be ſo much as named. And even in *Europe*, not one in a hundred thouſand meddles with theſe Studies. Beſides, its Original and Riſe is ſo late, that many Ages were paſt before the very firſt Rudiments of Aſtronomy or Geometry (which is neceſſary to the learning of it) were known. For every body is acquainted almoſt with its firſt beginnings in *Egypt* and *Greece*. Add to this,

this, that 'tis not yet above fourſcore years ſince the bungling Epicycles were diſcarded, and the true and eaſy plain Motion of the Planets was diſcover'd. For the ſatisfaction of theſe Scruples, to what we ſaid before, concerning the Fore-knowlege of God, may be added this; That God never deſign'd we ſhould come into the World Aſtronomers or Philoſophers; theſe Arts are not infus'd into us at our birth, but were order'd, in long tracts of Time, by degrees to be the rewards and reſult of laborious Diligence: eſpecially thoſe Sciences which are now in debate, are ſo much the more difficult and abſtruſe, that their late Invention and ſlow Progreſs are ſo far from being a wonder, that it is rather ſtrange they were ever diſcover'd at all. There are but few, I acknowlege one or two perhaps, in an age, that purſue them, or think them their buſineſs: but their number will be very conſiderable if we take in thoſe that have liv'd in all the ages in which Aſtronomy hath flouriſhed: and no body can deny them that happineſs and contentment which Book 1.

Book 1. they have pretended to above all others. In fine, it was ſufficient that ſo ſmall a number ſhould make it their ſtudy, ſo that the Profit and Advantage of their Inventions might but ſpread it ſelf over all the World. Since then the Inhabitants of this Earth, let them be never ſo few, have had Parts and Genius ſufficient for the attainment of this Knowlege; and there's no reaſon to think the Planetarians leſs ingenious or happy than our ſelves; we have gained our point, and 'tis probable that they are as skilful Aſtronomers as we can pretend to be. So that now we may venture to deduce ſome Conſequences from ſuch a Suppoſition.

We have before ſhow'd the neceſſary Dependence and Connexion, not only of Geometry and Arithmetick, but of mechanical Arts and Inſtruments with this Science. This leads us naturally to the enquiry how they can uſe theſe Inſtruments and Engines for the obſervation of the Stars, how they can write down ſuch their Obſervations, and perform other things which we do with our hands. So that

that we must necessarily give them hands, or some other Member, as convenient for all those uses, instead of them. I know an antient Philosopher laid such stress upon the use and conveniency of the hands, that he made no scruple to affirm, they were the cause and foundation of all our Knowlege. By which, I suppose, he meant no more, than that without their help and assistance men could never arrive to the improvement of their Minds in natural Knowlege: And truly not without reason. For suppose instead of them they had had Hoofs like Horses or Bullocks given them, they might have laid indeed the model and design of them in their Head, but they would never have been able to have built Cities and Houses. They would have had no Subject of Discourse but what belong'd to their Victuals, Marriages, or Self-preservation. They would have been void of all Knowlege and Memory, and indeed would have been but one degree distant from brute Beasts. What could we invent or imagine that could be so

Book 1.

They have Hands.

Book 1. exactly accommodated to all the deſign'd uſes as the Hands are? Shall we give them an Elephants Proboſcis. 'Tis true, theſe Beaſts can lay hold of, or throw any thing, can take up even the ſmalleſt things from the Ground, and can perform ſuch admirable feats with it, that it has not very improperly been call'd their Hand, tho indeed it is nothing but a Noſe ſomewhat longer than ordinary. Nor do Birds ſhow leſs Art and Deſign in the uſe of their Bills in the picking up their Meat, and the wonderful compoſure of their Neſts. But all this is nothing to thoſe Conveniences the Hand is ſo admirably ſuted to; nothing to that amazing contrivance in its capacity of being ſtretch'd, or contracted, or turned to any part as occaſion ſhall require. And then, to paſs by that nice Senſe that the ends of the Fingers are endued with, even to the feeling and diſtinguiſhing moſt ſorts of Bodies in the dark, what Wiſdom and Art is ſhow'd in the diſpoſition of the Thumb and Fingers, ſo as to take up or keep faſt hold of any thing we pleaſe? Either

ther then the Gentlemen that live there must have Hands, or somewhat equally convenient, which is no easy matter; or else we must say that Nature has been kinder not only to us, but even to Squirrels and Monkeys than them. Book I.

That they have Feet scarce any one can doubt, that does but consider what we said but just now of the different methods of Progression, which it's hard to imagin can be perform'd any other ways than what we there recounted. And, of all those, there's none can agree so well with the state of the Planetarians, as that that we here make use of. Except (what is not very probable, if they live in Society, as I shall show they do) they have found out the art of flying in some of those Worlds. *And Feet.*

The Stature and Shape of Men here does show forth the Divine Providence so much in its being so fitly adapted to its design'd Uses, that it is not without reason that all the Philosophers have taken notice of it, nor without probability that the Planetarians *That they are upright*

Book I. rians have their Eyes and Countenance upright, like us, for the more convenient and easy Contemplation and Observations of the Stars. And the Wisdom of the Creator is so observable, so praiseworthy in the position of the other Members; in the convenient situation of the Eyes, as Watches in the higher Region of the Body; in the removing of the more uncomly parts out of sight as 'twere; that we cannot but think he has almost observed the same Method in the Bodies of those remote Inhabitants. Nor does it follow from hence that they must be of the same shape with us. For there is such an infinite possible variety of Figures to be imagined, that both the Oeconomy of their whole Bodies, and every part of them, may be quite distinct and different from ours. How warmly and conveniently are some Creatures clothed with Wool, and how finely are others deck'd and adorn'd with Feathers? Perhaps among the rational Creatures in the Planets there may some such distinction be observ'd in their Garb and Covering;

It follows not therefore that they have the same shape with us.

vering; a thing in which Men are apt to envy the happineſs of Beaſts, tho perhaps without reaſon. For men might be born naked, only perhaps for the employment and exerciſing their Wits, in the inventing and making that Attire that Nature had made neceſſary for them. And 'tis this neceſſity that has been the greateſt, if not only occaſion of all the Trade and Commerce of all the Mechanical Inventions and Diſcoveries that we are maſters of. Beſides, Nature might have another great Conveniency in her eye, by bringing men into the World naked, namely, that they might accommodate themſelves to all places of the World, and go thicker or thinner cloth'd, according as the Seaſon and Climate they liv'd in required. There may ſtill be a greater difference between us and them; for there is a ſort of Animals in the World, as Oyſters, Lobſters, and Crab-fiſh, whoſe Fleſh is on the inſide of their Bones as 'twere. What if the Planetarians ſhould be ſuch? O no, ſome body will ſay, it would be a hideous ſight, ſo

Book 1. ſo ugly, that Nature has not made any but her refuſe and meaner Creatures of ſuch an odd Compoſition. As for that, I ſhould not be at all moved with their ugly ſhape, if it were not, that hereby they would be deprived of that quick eaſy motion of their Hands and Fingers, which is ſo uſeful and neceſſary to them.

A rational Soul may inhabit another Shape than ours.

For 'tis a very ridiculous opinion, that the common people have got among them, that it is impoſſible a rational Soul ſhould dwell in any other ſhape than ours. And yet as ſilly as 'tis, it has been the occaſion of many Philoſophers allowing the Gods no other ſhape; nay, the Foundation of a Sect among the Chriſtians, that from hence have the name of *Anthropomorphites*. This can proceed from nothing but the Weakneſs, Ignorance, and Prejudice of Men; as well as that too of humane Figure being the handſomeſt and moſt excellent of all others, when indeed it's nothing but a being accuſtomed to that figure that makes us think ſo, and a conceit that we and all other Animals naturally

rally have, that no shape or colour can be so good as our own. Yet methinks this fancy has such a rule upon my mind, that I cannot without horror and impatience suffer any other figure for the habitation of a reasonable Soul. For when I do but represent to my Imagination or Eyes a Creature like a Man in every thing else, but that has a Neck four times as long, and great round sawcer Eyes five or six times as big, and farther distant, I cannot look upon't without the utmost aversion, altho at the same time I can give no account of my Dislike. Book 1.

The Planetarians not less than we.

As I was talking somewhat above of the Stature of the Planetary Inhabitants, I hinted that 'twas improbable they should be less than we are. For it's likely, that as our Bodies are made in such a proportion to our Earth, as to render us capable of travelling about it, and making Observations upon its bulk and figure, the same Order is observ'd in the Inhabitants of the other Planets, except here too our Pride put in for our Preeminence. Then seeing we have before allow'd

Book 1. allow'd them Aſtronomy and Obſervations, we muſt give them Bodies and Strength ſufficient for the ruling their Inſtruments, and the erecting their Tubes and Engines. And for this the larger they are the better. For if we ſhould make them little Fellows about the bigneſs of Rats or Mice, they could neither make ſuch Obſervations as are requiſite; nor ſuch Inſtruments as are neceſſary to thoſe Obſervations. Therefore we muſt ſuppoſe them larger than, or at leaſt equal to our ſelves, eſpecially in *Jupiter* and *Saturn*, which are ſo vaſtly bigger than the Planet which we inhabit.

They live in Society.

Aſtronomy, we ſaid before, could never ſubſiſt without the writing down the Obſervations: nor could the Art of Writing (any more than the Carpenters and Founders) ever be found out except in a Society of reaſonable Creatures, where the neceſſities of Life forc'd them upon Invention: So that what I promis'd to prove follows from hence, namely, that the Planetarians muſt in this be like us, that they maintain a Society and Fellowſhip

lowſhip with, and afford mutual Aſ- Book 1.
ſiſtances and Helps to one another. Hereupon we muſt allow them a ſettled, not a wandring *Scythian* way of living, as more convenient for men in ſuch circumſtances. But what then? Shall they have every thing elſe proper for ſuch a manner of living granted them too? Shall they have their Governours, Houſes, Cities, Trade, and Bartering? Why not? when even the barbarous People of *America* and other places were at their firſt diſcovery found to have ſomewhat of that nature in uſe among them. I won't ſay, that things muſt be the ſame there as they are here. We have many that may very well be ſpared among rational Creatures, and were deſign'd only for the preſervation of Society from all Injury, and for the curbing of thoſe men who make an ill uſe of their Reaſon to the detriment of others. Perhaps in the Planets they have ſuch plenty and affluence of all good things, as they neither need or deſire to ſteal from one another; perhaps they may be ſo juſt and good as to be at perpetual Peace,

Book 1. Peace, and never to lie in wait for, or take away the Life of their Neighbour: perhaps they may not know what Anger or Hatred are; which we to our coſt and miſery know too too well. But ſtill it's more likely they have ſuch a medly as we, ſuch a mixture of good with bad, of wiſe with fools, of war with peace, and want not that Schoolmiſtreſs of Arts Poverty. For theſe things are of no ſmall uſe: and if there were no other, 'twould be reaſon enough that we are as good Men as themſelves.

They enjoy the pleaſures of Society.

What I am now going to ſay may ſeem ſomewhat more bold, and yet is not leſs likely than the former. For if theſe new Nations live in Society, as I have pretty well ſhow'd they do, 'tis ſomewhat more than probable that they enjoy not only the Profit, but the Pleaſures ariſing from ſuch a Society: ſuch as Converſation, Amours, Jeſting, and Sights. Otherwiſe we ſhould make them live like ſo many *Catos*, without Diverſion or Merriment; we ſhould deprive them of the great Sweetneſs of Life, which it can't well be

be without, and give our ſelves ſuch an advantage over them as Reaſon will by no means admit of. Book 1.

But to proceed to a farther Enquiry into their Buſineſs and Employment, let's conſider what we have not already mention'd, wherein they may bear any likeneſs to us. And firſt we have good reaſon to believe they build themſelves Houſes, becauſe we are ſure they be not without their Showers. For in *Jupiter* have been obſerv'd Clouds, big no doubt with Vapors and Water, which hath been proved by many other Arguments, not to be wanting in that Planet. They have then their Rain, for otherwiſe how could all the Vapors drawn up by the heat of the Sun be diſpoſed of? and their Winds, for they are cauſed only by Vapors diſſolved by heat, and it's plain that they blow in *Jupiter* by the continual motion and variety of the Clouds about him. To protect themſelves from theſe, and that they may paſs their Nights in quiet and ſafety, they muſt build themſelves Tents or Huts, or live in holes of the Earth.

They have Houſes to ſecure 'em from Weather.

Book 1. For I dare not affront the Pride of Men ſo much as to ſay, they are as good Architects, have as noble Houſes, and as ſtately Palaces as our ſelves. And good now who are we? Why a company of mean fellows living in a little corner of the World, upon a Ball ten thouſand times leſs than *Jupiter* or *Saturn*. And yet we forſooth muſt be the only skilful People at Building: and all others muſt be our Inferiours in the knowlege of uniform Symmetry; and not be able to raiſe Towers and Pyramids as high, magnificent, and beautiful, as our ſelves. For my part, I ſee no reaſon why they may not be as great Maſters at it as we are, and have the uſe of all thoſe Arts ſubſervient to it, as Stone-cutting and Brick-making, and whatſoever elſe is neceſſary for it, as Iron, Lead and Glaſs; or ornamental to it, as Gilding and Picture.

If their Globe is divided like ours, between Sea and Land, as it's evident it is (elſe whence could all thoſe Vapors in *Jupiter* proceed?) we have great reaſon to allow them the Art of Navi-

Navigation, and not proudly ingroſs so great, ſo uſeful a thing to our ſelves. Eſpecially conſidering the great advantages *Jupiter* and *Saturn* have for ſailing, in having ſo many Moons to direct their Courſe, by whoſe guidance they may attain eaſily to the Knowlege that we are not Maſters of, of the Longitude of Places. And what a troop of other things follow from this allowance? If they have Ships, they muſt have Sails and Anchors, Ropes, Pullies, and Rudders, which are of particular uſe in directing a Ship's Courſe againſt the Wind, and in ſailing different ways with the ſame Gale. And perhaps they may not be without the uſe of the Compaſs too, for the magnetical matter, which continually paſſes through the Pores of our Earth, is of ſuch a nature, that it's very probable the Planets have ſomething like it. But there's no doubt but that they muſt have the Mechanical Arts and Aſtronomy, without which Navigation can no more ſubſiſt, than they can without Geometry. Book 1.

They have Navigation, and all Arts ſubſervient:

Book 1. But Geometry ſtands in no need of being proved after this manner. Nor doth it want aſſiſtance from other Arts which depend upon it, but we may have a nearer and ſhorter aſſurance of their not being without it in thoſe Earths. For that Science is of ſuch ſingular worth and dignity, ſo peculiarly imploys the Underſtanding, and gives it ſuch a full comprehenſion and infallible certainty of Truth, as no other Knowlege can pretend to: it is moreover of ſuch a nature, that its Principles and Foundations muſt be ſo immutably the ſame in all times and places, that we cannot without Injuſtice pretend to monopolize it, and rob the reſt of the Univerſe of ſuch an incomparable Study. Nay Nature it ſelf invites us to be Geometricians: it preſents us with Geometrical Figures, with Circles and Squares, with Triangles, Polygones, and Spheres, and propoſes them as it were to our conſideration and ſtudy, which abſtracting from its Uſefulneſs, is moſt delightful and raviſhing. Who can read *Euclid*, or *Apollonius*, about

As Geometry.

about the Circle, without admiration? Book 1.
or *Archimedes* of the Surface of the
Sphere, and Quadrature of the Para-
bola without amazement? or conſider
the late ingenious Diſcoveries of the
Moderns with Boldneſs and Uncon-
cernedneſs? And all theſe Truths are
as naked and open, and depend upon
the ſame plain Principles and Axioms
in *Jupiter* and *Saturn* as here, which
makes it not improbable that there are
in the Planets ſome who partake with
us in theſe delightful and pleaſant Stu-
dies. But what's the greateſt Argu-
ment with me, that there are ſuch is
their uſe, I had almoſt ſaid neceſſity,
in moſt Affairs of humane Life. Now
we are got thus far, what if we ſhould
venture ſomewhat farther, and tell
you, that they have our Inventions of
the Tables of Sines, of Logarithms,
and Algebra: I know I ſhould be
laugh'd at for an idle Diſcoverer of no-
thing but ridiculous Whimſies, and yet
there's no reaſon but the old one, of
our being better than all the World,
to hinder them from being as happy
in their Diſcoveries, and as ingenious

Book 1. in their Inventions as we our ſelves are.

They have Muſick.

It's the ſame with Muſick as with Geometry, it's every where immutably the ſame, and always will be ſo. For all Harmony conſiſts in Concord, and Concord is all the World over fixt according to the ſame invariable meaſure and proportion. So that in all Nations the difference and diſtance of Notes is the ſame, whether they be in a continued gradual progreſſion, or the voice makes skips over one to the next. Nay very credible Authors report, that there's a ſort of Bird in *America*, that can plainly ſing in order ſix muſical Notes: whence it follows that the Laws of Muſick are unchangeably fix'd by Nature, and therefore the ſame Reaſon holds valid for their Muſick, as we e'en now propoſed for their Geometry. For why, ſuppoſing other Nations and Creatures, endued with Reaſon and Senſe as well as we, ſhould not they reap the Pleaſures ariſing from theſe Senſes as well as we too? I don't know what effect this Argument, from the immutable nature of theſe Arts,

Arts, may have upon the Minds of others; I think it no inconſiderable or contemptible one, but of as great Strength as that which I made uſe of above to prove that the Planetarians had the ſenſe of Seeing. Book 1.

But if they take delight in Harmony, 'tis twenty to one but that they have invented muſical Inſtruments. For, if nothing elſe, they could ſcarce help lighting upon ſome or other by chance; the ſound of a tight String, the noiſe of the Winds, or the whiſtling of Reeds, might have given them the hint. From theſe ſmall beginnings they perhaps, as well as we, have advanced by degrees to the uſe of the Lute, Harp, Flute, and many ſtring'd Inſtruments. But altho the Tones are certain and determinate, yet we find among different Nations a quite different manner and rule for Singing; as formerly among the Dorians, Phrygians, and Lydians, and in our time among the French, Italians, and Perſians. In like manner it may ſo happen, that the Muſick of the Inhabitants of the Planets may widely differ

Book 1. from all theſe, and yet be very good. But why we ſhould look upon their Muſick to be worſe than ours, there's no reaſon can be given; neither can we well preſume that they want the uſe of half-notes and quarter-notes, ſeeing the invention of half-notes is ſo obvious, and the uſe of 'em ſo agreeable to nature. Nay, to go a ſtep farther, what if they ſhould excel us in the Theory and practick part of Muſick, and outdo us in Conſorts of vocal and inſtrumental Muſick, ſo artificially compos'd, that they ſhew their Skill by the mixtures of Diſcords and Concords? and of this laſt ſort 'tis very likely the 5*th* and 3*d* are in uſe with them.

This is a very bold Aſſertion, but it may be true for ought we know, and the Inhabitants of the Planets may poſſibly have a greater inſight into the Theory of Muſick than has yet bin diſcover'd amongſt us. For if you ask any of our Muſicians, why two or more perfect fifths cannot be us'd regularly in compoſition; ſome ſay 'tis to avoid that Sweetneſs and Luſhiouſneſs which ariſes from the repetition of this pleaſing

ſing Chord: Others ſay, this muſt be avoided for the ſake of that variety of Chords that are requiſite to make a good compoſition; and theſe Reaſons are brought by *Cartes* and others. But an Inhabitant of *Jupiter* or *Venus* will perhaps give you a better reaſon for this, *viz.* becauſe when you paſs from one perfect fifth to another, there is ſuch a change made as immediately alters your Key, you are got into a new Key before the Ear is prepared for it, and the more perfect Chords you uſe of the ſame kind in Conſecution, by ſo much the more you offend the Ear by theſe abrupt Changes. Book 1.

Again, one of theſe Inhabitants will tell you how it comes about, that in a Song of one or more Parts, the Key cannot be kept ſo well in the ſame agreeable Tenor, unleſs the intermediate Cloſes and Intervals be ſo temper'd, as to vary from their uſual Proportions, and thereby to bear a little this way or that, in order to regulate the Scale. And why this Temperature is beſt in the Syſtem of the Strings, when out of the fifth the fourth part of a Comma

Book 1. Comma is uſually cut off; This ſame thing I have formerly ſhew'd at large.

But for the regulating the Tone of the Voice (as I before hinted) that may admit of a more eaſy proof, and we ſhall give you an Eſſay of it, being unwilling ſtill to put you off with my own whims: I ſay therefore, if any Perſons ſtrike thoſe Sounds which the Muſicians diſtinguiſh by theſe Letters, C, F, D, G, C, by theſe agreeable Intervals, altogether perfect, interchangable, aſcending and deſcending with the Voice: Now this latter ſound C will be one Comma, or very ſmall portion lower than the firſt ſounding of C. Becauſe of theſe perfect Intervals, which are as 4 to 3, 5 to 6, 4 to 3, 2 to 3, an account is made in ſuch a proportion, as 160 to 162, that is as 80 to 81, which is what they call a Comma. So that if the ſame Sound ſhould be repeated nine times, the Voice would fall near the matter a greater Tone, whoſe proportion is as 8 to 9. But this the ſenſe of the Ears by no means endures, but remembers the firſt Tone, and returns to it again.

There-

Therefore we are compell'd to uſe an occult Temperament, and to ſing theſe imperfect Intervals, from doing which leſs offence ariſes. And for the moſt part, all Singing wants this Temperament, as may be collected by the aforeſaid Computations. And theſe things we have offer'd to thoſe that have ſome Knowlege in Geometry. Book 1.

We have ſpoke of theſe Arts and Inventions, which it is very probable the Inhabitants of the Planets partake of in common with us, beſides which it ſeems requiſite to take in many other things that ſerve either for the uſe or pleaſure of their Lives. But what theſe things are we ſhall the better account for, by laying before us many of thoſe things which are found amongſt us. I have before mention'd the variety of Animals and Vegetables, which very much differ from each other, among which there are ſome that differ but little; and I have ſaid, that there are no leſs differences in theſe things in the Planetary Worlds.

I ſhall now take a ſhort view of the Benefits we receive both from thoſe Herbs

Book 1. Herbs and Animals, and ſee whether we may not with very good reaſon conclude that the Planetarians reap as great and as many from thoſe that their Countries afford them.

And here it may be worth our while to take a review of the variety and multitude of our Riches. For Trees and Herbs do not only ſerve us for Food, they in their delicious Fruits, theſe in their Seeds, Leaves and Roots; but Herbs moreover furniſh us with Phyſick, and Trees with Timber for our Houſes and Ships. Flax, by the means of thoſe two uſeful Arts of Spinning and Weaving, affords us Clothing. Of Hemp or Matweed we twiſt our ſelves Thread and ſmall Ropes, the former of which we employ in Sails and Nets, the latter in making larger Ropes for Maſts and Anchors. With the ſweet Smells and beauteous Colours of Flowers we feaſt our Senſes: and even thoſe of them that offend our Noſtrils, or are miſchievous to our Bodies, are ſeldom without excellent uſes: or were made perhaps by Nature as a foil to ſet off,

The Advantages we reap from Herbs and Animals.

and

and make us the more value the good Book 1.
by comparing them with theſe. What
vaſt advantages and profit do we reap
from the Animals? The Sheep give us
Clothing, and the Cows afford us
Milk: and both of them their Fleſh
for our Suſtenance. Aſſes, Camels,
and Horſes do, what if we wanted
them we muſt do ours ſelves, carry
our Burdens; and the laſt of them we
make uſe of, either themſelves to car-
ry us, or in our Coaches to draw us.
In which we have ſo excellent, ſo uſe-
ful an Invention of Wheels, that I
can't let the Planets enjoy Society and
all its conſequences, and be without
them. Whether they are Pythagore-
ans there, or feed upon Fleſh as we
do, I dare not affirm any thing. Tho
it ſeems to be allow'd Men to feed up-
on whatſoever may afford them Nou-
riſhment, either on Land, or in Wa-
ter, upon Herbs, and Pomes, Milk,
Eggs, Honey, Fiſh, and no leſs upon
the Fleſh of many Birds and Beaſts.
A ſtrange thing! that a rational Crea-
ture ſhould live upon the Ruin and
Deſtruction of ſuch a number of other

his

Book 1. his Fellow-Creatures! And yet not at all unnatural ſhould it ſeem, ſince not only he, but even Lions, Wolves, and other ravenous Beaſts, prey upon Flocks of other harmleſs things, and make mere Fodder of them; as Eagles do of Pidgeons and Hares; and large Fiſh of the helpleſs little ones. We have different ſorts of Dogs for Hunting, and what our own Legs cannot, that their Noſe and Legs can help us to. But the Uſe and Profit of Herbs and Animals are not the only things they are good for, but they raiſe our delight and admiration when we conſider their various Forms and Natures, and enquire into all their different ways of Generation: things ſo infinitely multifarious, and ſo delightfully amazing, that the Books of Natural Philoſophers are deſervedly fill'd with their Encomiums. For even in the very Inſects, who can but admire the ſix-corner'd Cells of the Bees, or the artificial Web of a Spider, or the fine Bag of a Silk-worm, which laſt affords us, with the help of incredible Induſtry, even Shiploads of ſoft delicate Clothing,

Clothing. This is a ſhort Summary of thoſe many profitable Advantages the animal and herbal World ſerve us with. Book 1.

But this is not all. The Bowels of the Earth too muſt contribute to Man's Happineſs. For what art and cunning does he employ in finding, in digging, in trying Metals, and in melting, refining, and tempering them? What Skill and Nicety in beating, drawing or diſſolving Gold, ſo as with inconſiderable changes to make every thing he pleaſes put on that noble Luſtre? Of how many and admirable uſes is Iron? and how ignorant in all Mechanical Knowlege were thoſe Nations that were not acquainted with it, ſo as to be fain to uſe no Arms but Bows, Clubs, and Spears, made of Wood. Poor Weapons! There's one thing indeed we have, which it's a queſtion whether it has done more harm or good, and that's a deviliſh Powder made of Nitre and Brimſtone. At firſt indeed it ſeem'd as if we had got a more ſecure Defence than former Ages againſt all Aſſaults, and could eaſily

And from Metals.

Book 1. eaſily guard our Towns, by the wonderful ſtrength of that Invention, againſt all hoſtile Invaſions: but now we find it has rather encouraged them, and at the ſame time bin no ſmall occaſion of the decay of Valor, by rendring it and Strength almoſt uſeleſs in War. Had the Grecian Emperor who ſaid, *Virtue was ruin'd* only when Slings and Rams firſt came into uſe, liv'd in our days, he might well have complain'd; eſpecially of Bombs, againſt which neither Art nor Nature is of ſufficient proof: but which be it never ſo ſtrong, lays every thing, Caſtles and Towers, even with the Ground. If for nothing elſe, yet upon this one account, I think we had better have bin without the Diſcovery. Yet, when we were talking of our Diſcoveries, it was not to be paſs'd over, for the Planets too may have their miſchievous as well as uſeful Inventions.

We are happier in the uſes for which the Air and Water ſerve us; both of which help us in our Navigation, and furniſh us with a Strength ſuffi-

ſufficient, without any labor of our own, to turn round our Mills and Engines; things which are of uſe to us in ſo many different Employments. For with them we grind our Corn, and ſqueeze out our Oyl; with them we cut Wood, and mill Cloth, and with them we beat our ſtuff for Paper. An incomparable Invention! Where the naſtieſt uſeleſs ſcraps of Linen are made to produce fine white Sheets. To theſe we may add the late diſcovery of Printing, which not only preſerves from Death Arts and Knowlege, but makes them much eaſier to be attained than before. Nor muſt we forget the Arts of Engraving and Painting, which from mean beginnings have improv'd to that Excellence, that nothing that ever ſprung from the Wit of Man can claim Preeminence to them. Nor is the way of melting and blowing Glaſſes, and of poliſhing and ſpreading Quickſilver over Mirrors, unworthy of being mention'd, nor above all the admirable uſes that Glaſſes have bin put to in natural Knowlege, ſince the invention Book 1.

Book 1. of the Teleſcope and Microſcope. And no leſs nice and fine is the Art of making Clocks, ſome of which are ſo ſmall as to be no weight to the Bearer; and others ſo exact as to meaſure out the Time in as ſmall Portions as any one can deſire: the improvement of both which the World owes to my * Inventions.

* *The Author invented the Pendulum for Clocks.*

From the diſcoveries of our Age.

I might add much here of the late Diſcoveries, moſt of them of this age, which have bin made in all ſorts of Natural Knowlege as well as in Geometry and Aſtronomy, as of the weight and ſpring of the Air, of the Chymical Experiments that have brought to light a way of making Liquors that ſhall ſhine in the dark, and with gentle moving ſhall burn of themſelves. I could tell you of the Circulation of the Blood through the Veins and Arteries, which was underſtood indeed before; but now, by the help of the Microſcope, has an ocular Demonſtration in the Tails of ſome Fiſhes: of the Generation of Animals, which now is found to be perform'd no otherwiſe than by the Seed of one

of

of the ſame kind; and that in the Seed of the Male are diſcover'd, by the help of Glaſſes, Millions of ſprightly little Animals, which it's probable are the very Offspring of the Animals themſelves: a wonderful thing, and never before now known! Book 1.

Thus have I heap'd together all theſe late Diſcoveries of our Earth: and now, tho perhaps ſome of them may be common to the Planetarians with us, yet that they ſhould have all of them is not credible. But then they have ſomewhat to make up that defect, others as good and as uſeful, and as wonderful, that we want. We have allow'd that they may have rational Creatures among them, and Geometricians, and Muſicians: we have prov'd that they live in Societies, have Hands and Feet, are guarded with Houſes and Walls: yet if a Man was but carried thither by ſome powerful Genius, ſome *Pegaſus*, I don't doubt 'twould be a very pretty ſight, pretty beyond all imagination, to ſee the odd ways, and the unuſual manner of their ſetting about any thing, and their

The Planets have, tho not theſe ſame, yet as uſeful Inventions.

Book 1. ſtrange methods of living. But ſince there's no hopes of a *Mercury* to carry us ſuch a Journey, we ſhall e'en be contented with what's in our power: we ſhall ſuppoſe our ſelves there, and inquire as far as we can into the Aſtronomy of each Planet, and ſee in what manner the Heavens preſent themſelves to their Inhabitants. We ſhall make ſome Obſervations of the Eminence of each of them, in reſpect of their Magnitude, and number of Moons they have to wait on them; and ſhall propoſe a new Method of coming to ſome knowlege of the incredible diſtance of the fix'd Stars. But firſt after this long Trouble we will give our Reader a breathing while.

New

New Conjectures concerning the Planetary Worlds.

BOOK the Second.

'TWAS a pretty many years ago that I chanc'd to light upon *Athanasius Kircher*'s Book, call'd, *The Ecstatick Journey*, which treats of the nature of the Stars, and of all things that are to be found in the Planets: I wonder'd to see nothing there of what I had often thought not improbable, but quite other things, nothing but a company of idle unreasonable stuff: which I was the more confirm'd in, when, after the writing of the former part, I ran over the Book again. And methoughts mine were very notable weighty Matters if but compar'd with *Kircher*'s. That other People may be satisfied in this, and see how vainly those, who cast off the only Foundations of Probability in such matters, which we have all the way made use of, pretend to philoso-

Book 2. phize in this caſe, I don't care if I beſtow ſome few Reflections upon that Book.

Kircher's *Journey in Ecſtacy examin'd.*

That ingenious Man ſuppoſing himſelf carry'd by ſome Angel through the vaſt ſpaces of Heaven, and round the Stars, tells us, he ſaw a great many things, ſome of which he had out of the Books of Aſtronomers, the reſt are the product of his own Fancy and Thoughts. But, before he enters upon his Journey, he lays down theſe two things as certain; that no Motion muſt be allow'd the Earth, and that God has made nothing in the Planets, no not ſo much as Herbs, which has either Life or Senſe in it. Leaving then the Syſtem of *Copernicus*, he chuſes *Tycho* for his Guide. But when he ſuppoſes all the fix'd Stars to be Suns, and round each of them places their Planets, here (againſt his will I ſuppoſe) he has unawares made an infinite number of *Copernican* Syſtems. All which, beſides their own Motion, he abſurdly makes to be carry'd, with a monſtrous ſwiftneſs, in twenty four hours, round the Earth. When moſt of theſe Worlds are out of the reach of

of any Man's ſight, as he owns they are, I cannot think for what he makes ſo many Suns to ſhine upon deſolate Lands (like our Earth in every thing, he ſays, only that they have neither Plants nor Animals) where there's no one to whom they ſhould give light. And from hence he ſtill falls into more and more Abſurdities. And becauſe he could find no other uſe of the Planets, even in our Syſtem, he is forc'd to beg help of the Aſtrologers; and would have all thoſe vaſt Bodies made upon no other account than to preſerve and rule the inferior World by, and govern the Mind of Man by their various and regular Influences. Accordingly, to gratify Aſtrology, he ſays that *Venus* was the prettieſt pleaſant place, every thing fine and handſom, its Light gentle, its Waters ſweet and purling, and it ſelf beſet all about with ſhining Cryſtals. In *Jupiter* he found wholeſom and ſweet Gales, delicate Waters, and a Land ſhining like Silver. For from theſe two Planets forſooth, Men have all that is happy and healthful poured down upon them; and all that renders Book 2.

Book 2. them handſom and lovely, wiſe and grave, is owing to their Influences. *Mercury* had I don't know what ye call't, Airineſs and Briskneſs about him; whence Men derive, when they are firſt born, all their Wit and Cunning. *Mars* was nothing but deviliſh, infernal, ſtinking, black Flames and Smoke: and *Saturn* was all melancholy, dreadful, naſty, and dark: for theſe are the Planets (I don't know why, but all your Fortune-tellers hate them) that bring all the Plagues and Miſchiefs that we feel upon us, and would exerciſe their ſpite ſtill more, except they were ſometimes mitigated and corrected by the benign and kind Influences of the other Planets. All this fine ſtuff his Genius teaches him. Which he makes give a ſerious Anſwer to this idle Queſtion, Whether a Jew or Heathen could be duly and rightly baptiz'd in the Waters of *Venus?* Of him too he learns that the Heaven of the fix'd Stars is no ſolid ſtuff, but a thin fluid, wherein an innumerable company of Stars and Suns lie floating here and there, not chain'd down to any place, (thus far he's in the

the right) and making in the ſpace of Book 2.
a day that prodigious Tour round the
Earth. He forgets here, if there were
ſuch a Motion, with what an incredi-
ble ſwiftneſs they would fly out from
their Centers. But I ſuppoſe the In-
telligences that he has plac'd in them
will take care of that, thoſe Angels
that preſide over, and regulate their
Motions. And in that he follows a
company of Doctors that harbour'd
that idle fancy of *Ariſtotle* upon no ac-
count or conſideration. But *Coperni-
cus* has ſet them all at liberty, only by
bringing in the Motion of the Earth:
which, if upon no other account, eve-
ry one that is not blind purpoſely muſt
own to be neceſſary upon this. I dare
ſay *Kircher*, if he had dar'd freely to
ſpeak his mind, could have afforded
us othergueſs things than theſe. But
when he could not have that liberty,
I think he might as well have let the
whole matter alone. But enough,
let's have done with this famous Au-
thor: And now that we have ven-
tur'd to place Spectators in the Planets,
let's take a Journey to each of them,
and

Book 2. and see what their Years, Days, and Astronomy are.

The System of the Planets in Mercury.

To begin with the innermost and nearest the Sun: We know that *Mercury* is three times nearer that vast body of Light than we are. Whence it follows that they see him three times bigger, and feel him nine times hotter than we do. Such a degree of Heat would be intolerable to us, and set afire all our dry'd Herbs, our Hay and Straw that we use. And yet I warrant the Animals there, are made of such a temper, as to be but moderately warm, and the Plants such as to be able to endure the Heat. The Inhabitants of *Mercury*, it's likely, have the same opinion of us that we have of *Saturn*, that we must be intolerably cold, and have little or no Light, we are so far from the Sun. There's reason to doubt, whether the *Mercurians*, tho they live so much nearer the Sun, the Fountain of Life and Vigour, are much more airy and ingenious than we. For if we may guess at them by what we see here, we shall not be obliged to grant it the

the Inhabitants of *Africa* and *Braſil*, Book 2.
that have got for their ſhare the hotteſt places in the Earth, being neither ſo wiſe nor ſo induſtrious as thoſe that belong to colder and more temperate Climates; they have ſcarce any Arts or Knowlege among them, and thoſe of them that live upon the very ſhore, underſtand little or no Navigation. Nor can I be willing to make all that vaſt number that muſt inhabit thoſe two large Planets, *Jupiter* and *Saturn*, and have ſuch noble Attendance, mere dull Blockheads, or without as much Wit as our ſelves, tho they are ſo far more diſtant from the Sun. The Aſtronomy of the *Mercurials*, and the appearance of the Planets to them, oppoſite at certain times to the Sun, may be eaſily conceived by the Scheme of the *Copernican* Syſtem in the former Part. At the times of theſe Oppoſitions *Venus* and the Earth muſt needs appear very bright and large to them. For if *Venus* ſhines ſo gloriouſly to us when ſhe is new and horned, ſhe muſt neceſſarily in oppoſition to the Sun, when ſhe is full, be at leaſt ſix or ſeven

Book 2. ven times larger, and a great deal nearer to the Inhabitants of *Mercury*, and afford them Light ſo ſtrong and bright, that they have no reaſon to complain of their want of a Moon. What the length of their Days are, or whether they have different ſeaſons in the Year, is not yet diſcover'd, becauſe we have not yet bin able to obſerve whether his Axis have any inclination to his Orbit, or what time he ſpends in his diurnal Revolution upon himſelf. And yet ſeeing *Mars*, the Earth, *Jupiter* and *Saturn*, have certainly ſuch Succeſſions, there's no reaſon to doubt but that he has his Days and Nights as well as they. But his Year is ſcarce the fourth part ſo long as ours.

In Venus. The Inhabitants of *Venus* have much the ſame face of things as thoſe in *Mercury*, only they never ſee him in oppoſition to the Sun, which is occaſioned by his never removing above 38 degrees, or thereabouts, from it. The Sun appears to them by half larger in his Diameter, and above twice in his Circumference, than to us:

us: and by conſequence affords them Book 2.
but twice as much Light and Heat, ſo
that they are nearer our Temperature
than *Mercury*. Their Year is com-
pleated in ſeven and a half of our
Months. In the Night our Earth,
when 'tis on the other ſide of the Sun
from *Venus*, muſt needs ſeem much
larger and lighter to *Venus* than ſhe
doth ever to us; and then they may
eaſily ſee, if they have not very weak
eyes, our conſtant Attendant the Moon.
I have often wonder'd that when I
have viewed *Venus* at her neareſt to
the Earth, when ſhe reſembled an
Half-moon, juſt beginning to have
ſomething like Horns, through a Te-
leſcope of 45 or 60 Foot long, ſhe al-
ways appeard to me all over equally
lucid, that I can't ſay I obſerv'd ſo
much as one ſpot in her, tho in *Jupi-
ter* and *Mars*, which ſeem much leſs
to us, they are very plainly perceived.
For if *Venus* had any ſuch thing as Sea
and Land, the former muſt neceſſarily
ſhow much more obſcure than the
other, as any one may ſatisfy himſelf,
that from a very high Mountain will
but

Book 2. but look down upon our Earth. I thought that perhaps the too brisk Light of *Venus* might be the occaſion of this equal appearance; but when I uſed an Eye-glaſs that was ſmok'd for the purpoſe, it was ſtill the ſame thing. What then, muſt *Venus* have no Sea, or do the Waters there reflect the Light more than ours do, or their Land leſs? or rather (which is moſt probable in my opinion) is not all that Light we ſee reflected from an Atmoſphere ſurrounding *Venus*, which being thicker and more ſolid than that in *Mars* or *Jupiter*, hinders our ſeeing any thing of the Globe it ſelf, and is at the ſame time capable of ſending back the Rays that it receives from the Sun? For it's certain that if we look'd on the Earth from the outſide of the Atmoſphere, we ſhould not perceive ſuch a difference as we do from a Mountain; but by reaſon of the interpoſed Atmoſphere, we ſhould obſerve very little diſparity between Sea and Land. 'Tis the ſame thing that hinders us from ſeeing the ſpots in the Moon as plain in the day as in the night,

night, becauſe the Vapors that ſur- Book 2.
round the Earth being then enlightned
by the Rays of the Sun, are an impe-
diment to our proſpect.

But *Mars*, as I ſaid before, has ſome *In* Mars.
Parts of him darker than other ſome.
By the conſtant Returns of which his
Nights and Days have bin found to be
of about the ſame length with ours.
But the Inhabitants have no perceiva-
ble difference between Summer and
Winter, the Axis of that Planet having
very little or no inclination to his Or-
bit, as has bin diſcover'd by the Moti-
on of his Spots. Our Earth muſt ap-
pear to them almoſt as *Venus* doth to
us, and by the help of a Teleſcope
will be found to have its Wane, In-
creaſe, and Full, like the Moon: and
never to remove from the Sun above
48 Degrees, by whoſe diſcovery they
ſee it, as well as *Mercury* and *Venus*,
ſometimes paſs. They as ſeldom ſee
Venus as we do *Mercury*. I am apt to
believe, that the Land in *Mars* is of a
blacker hue than that of *Jupiter* or the
Moon, which is the reaſon of his ap-
pearing of a Copper Colour, and his
reflect-

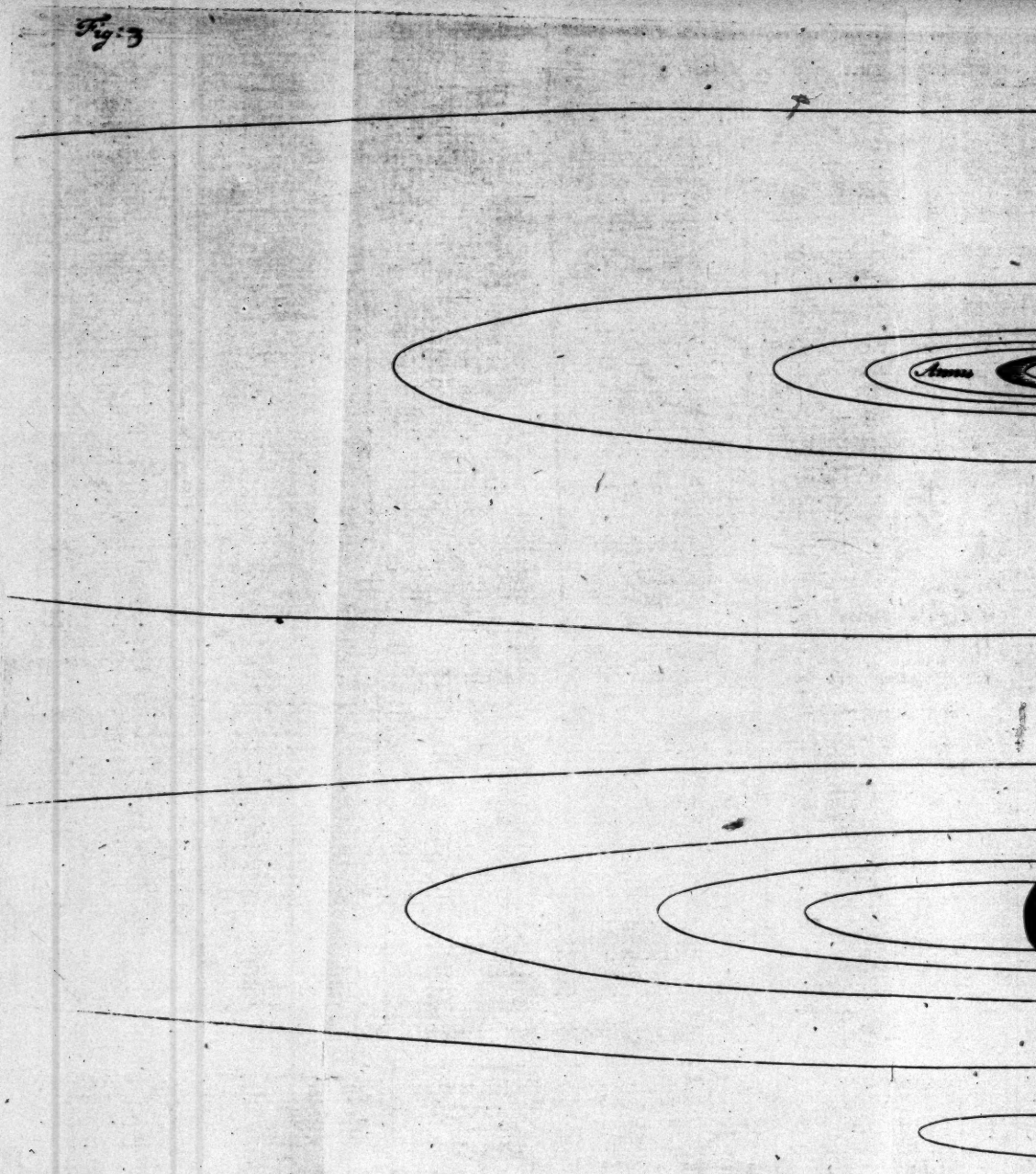
Book 2. reflecting a weaker Light than is proportionable to his distance from the Sun. His Body, as I observ'd before, tho farther from the Sun, is less than *Venus*. Nor has he any Moon to wait upon him, and in that, as well as *Mercury* and *Venus*, he must acknowlege himself our inferiour. His Light and Heat is twice, and sometimes three times less than ours, to which I suppose the Constitution of his Inhabitants is answerable.

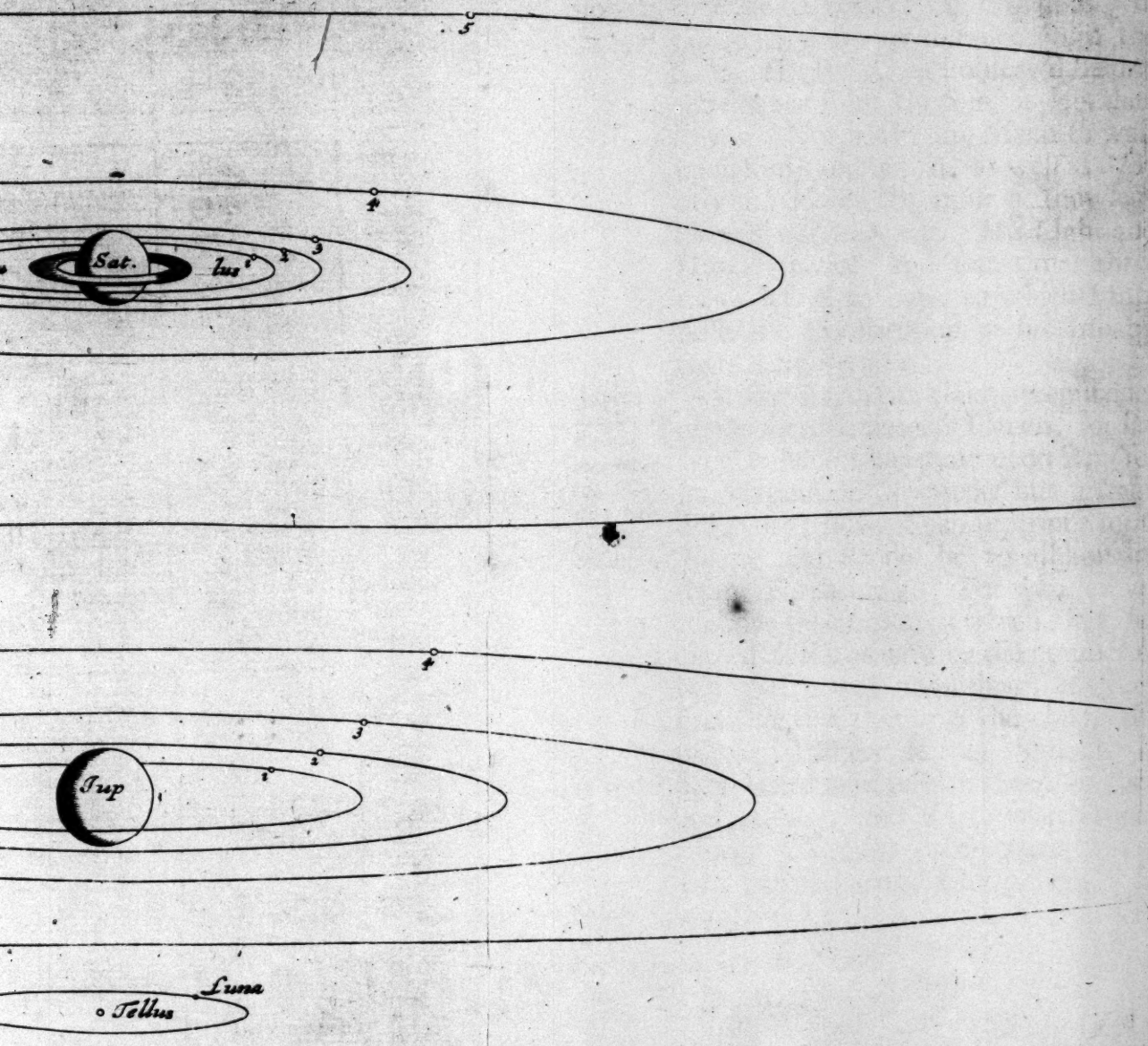
Jupiter and Saturn the most eminent of the Planets both for bigness and attendants.

If our Earth can claim preeminence of the fore-mentioned Planets, for having a Moon to attend upon it, (for its Magnitude can make but a small difference) how much superiour must *Jupiter* and *Saturn* be to all four of them, Earth and all? For whether we consider their bulk, in which they far exceed all the others, or the number of Moons that wait upon them, it's very probable that they are the chief, the primary Planets in our System, in comparison with which the other four are nothing, and scarce worth mentioning. For the easier conception of their vast disparity, I have thought fit

to

Fig: 3




5
4
Sat.
Ius
3
2
4
3
Jup
2
1
Luna
Tellus

to add a Scheme of our Earth, with the Path of the Moon about it, and the Globe of the Moon it ſelf; and the Syſtems of *Jupiter* and *Saturn*, where I have drawn every thing as near the true Proportion as poſſible. *Jupiter* you ſee has his four, and *Saturn* his five Moons about him, all plac'd in their Orbits. The *Jovial* we owe to *Galilæo*, 'tis well known: and any one may imagine he was in no ſmall rapture at the diſcovery. The outermoſt but one, and brighteſt of *Saturn*'s, it chanc'd to be my lot, with a Teleſcope not above 12 foot long, to have the firſt ſight of in the year 1655. The reſt we may thank the induſtrious *Caſſini* for, who uſed the Glaſſes of *Joſ. Campanus*'s Work, firſt of 36, and afterwards of as many above 100 foot long. He has often, and particularly in the year 1672, ſhow'd me the third and fifth. The firſt and ſecond he gave me notice of by Letters in the year 1684. but they are ſcarce ever to be ſeen, and I can't poſitively ſay I had ever that happineſs: but am as ſatisfied that they are

Book 2.

Fig. 3.

Book 2. there, as if I had; not in the leaſt ſuſpecting the Credit of that worthy man. Nay, I am afraid there are one or two more ſtill behind, and not without reaſon. For between the fourth and fifth there's a diſtance not at all proportionable to that between all the others: Here for ought I know may lurk a ſixth Gentleman; or perhaps there may be another without the fifth that may yet have eſcaped us: for we can never ſee the fifth but in that part of his Orbit, which is towards the Weſt: for which we ſhall give you a very good reaſon.

Perhaps when *Saturn* comes into the Northern Signs, and is at a good height from the Horizon (for at the writing of this he is at his loweſt) you may happen to make ſome new Diſcoveries, good Brother, if you would but make uſe of your two Teleſcopes of 170 and 210 foot long; the longeſt, and the beſt I believe now in the World. For tho we have not yet had an opportunity of obſerving the Heavens with them (as well by reaſon of their Unweildineſs, as for the

the interruption of our Studies by your abſence) yet I am ſatisfied of their Goodneſs by our trial of them one night, in reading a Letter at a vaſt diſtance by the help of a Light. I cannot but think of thoſe times with pleaſure, and of our diverting labour in poliſhing and preparing ſuch Glaſſes, in inventing new Methods and Engines, and always puſhing forward to ſtill greater and greater things. But to return to thoſe Diagrams. Book 2.

I have there made the Diameter of *Jupiter* about two third parts of our diſtance from the Moon: for the Diameter of *Jupiter* is above twenty times bigger than that of the Earth; which the diſtance of the Moon contains about thirty times. The Orbit of the outermoſt of *Jupiter*'s Guards is to that of the Moon round the Earth, as 8 and $\frac{1}{2}$ is to 1. And each of theſe Moons, by the ſhadow they make upon *Jupiter*, cannot be leſs than our Earth. Their Periods, that I may not omit them, are according to *Caſſini*'s account theſe. That of the inmoſt is one day, 18 hours, 28 minutes,

The proportion of the Diameter of Jupiter, *and of the Orbs of his Satellites, to the Orbit of the Moon round the Earth.*

The periods of Jupiter's *Moons.*

Book 2. and 36 ſeconds. The ſecond ſpends 3 days, 13 hours, 13 min. 52 ſec. in going round him. The third 7 days, 3 hours, 59 min. 40 ſec. The fourth 16 days, 18 hours, 5 min. 6 ſec. The diſtance of the innermoſt from *Jupiter* himſelf is 2 $\frac{1}{6}$ of his Diameters. That of the ſecond is 4 and a half: Of the third 7 and one ſixth part: Of the fourth 12 and two thirds, of the ſame Diameters. The innermoſt of *Saturn*'s Guards moves round him in 1 day, 21 hours, 18 min. 31 ſec. The ſecond in 2 days, 17 hours, 41 min. 27 ſec. The third in 4 days, 13 hours, 47 min. 16 ſec. The fourth in 15 days, 22 hours, 41 min. 11 ſec. The fifth in 79 days, 7 hours, 53 min. 57 ſec. Their diſtances from the Center of *Saturn* are, that of the firſt almoſt one, that is 39 fortieth parts of the Diameter of his Ring; that of the ſecond one and a quarter of thoſe Diameters; of the third one and three quarters of them; of the fourth four, or according to my calculation, but 3 and a half; of the fifth 12, which were found with vaſt pains and labour.

And Saturn's.

Now

Now can any one look upon, and compare theſe Syſtems together, without being amazed at the vaſt Magnitude and noble Attendance of theſe two Planets, in reſpect of this little pitiful Earth of ours? Or can they force themſelves to think, that the wiſe Creator has diſpoſed of all his Animals and Plants here, has furniſh'd and adorn'd this Spot only, and has left all thoſe Worlds bare and deſtitute of Inhabitants, who might adore and worſhip him; or that all thoſe prodigious Bodies were made only to twinkle to, and be ſtudied by ſome few perhaps of us poor fellows? Book 2.

I do not doubt but there will be ſome who will think we Romance very much about the Magnitude of theſe Planets. For will you pretend to make them who are taken up in admiring the largeneſs of this Globe, its multitude of Nations, Cities, and Empires; can you pretend I ſay to make them ever believe that there are Places in compariſon of which the Earth is as inconſiderable as my Figure would make it? No, they know better things

This proportion true, according to all modern Obſervations.

Book 2. they'l cry. But they may vouchſafe to be inform'd, that theſe Proportions are thoſe which the beſt Aſtronomers of this Age have agreed upon. For if the Earth be diſtant from the Sun ten or eleven thouſand of its own Diameters, according to the accounts of Monſieur *Caſſini* in *France*, and Mr. *Flamſted* in *England*, wherein they made uſe of very exact Obſervations of the Parallaxes of *Mars*; or if, according to a very probable Conjecture of mine, it be diſtant twelve thouſand, then the Magnitudes of the other Orbs will very near anſwer the Proportions here ſettled.

The apparent magnitude of the Sun in Jupiter, *and a way of finding what light they there enjoy.*

But to return to *Jupiter*. The Sun appears to them five times leſs than to us, and conſequently they have but the five and twentieth part of the Light and Heat that we receive from it. But that Light is not ſo weak as we imagine, as is plain by the brightneſs of that Planet in the Night; and that when the Sun is ſo far eclips'd to us, as that the 25*th* part of his Disk be not free from the Shadow, he is not ſenſibly darken'd. But if you have a mind

mind exactly to know the quantity of Light that *Jupiter* enjoys, you may take a Tube of what length you pleaſe. Let one end of it be clos'd with a Plate of Braſs, or any ſuch thing, in the middle of which there muſt be a hole, whoſe breadth muſt have the ſame proportion to the length of the Tube, as the Chord of 6 Minutes bears to the Radius; that is about as one is to 570. Let the Tube be turn'd ſo to the Sun, that no Light may fall upon a white Paper plac'd at the end of it, but what comes through the little hole at the other end of the Tube. The Rays that come through this will repreſent the Sun upon the Paper of the ſame Brightneſs that the Inhabitants of *Jupiter* ſee it in a clear day. And if removing the Paper you place your eye in the ſame place, you will ſee the Sun of the ſame Magnitude and Brightneſs as you would were you in *Jupiter*. Book 2.

If you make the hole twice as little in breadth, you will ſee the ſame of *Saturn*. And altho his Light be but the hundredth part of ours, yet you *And in Saturn.*

Book 2. ſee it makes him ſhine finely in a dark night. But in cloudy days what ſhall the poor Inhabitants do? Why if we were to be Judges but miſerably, but yet I warrant they do not at all complain. Perhaps they may be like Owls and Bats, and may love the Twilight better than open day.

In Jupiter *their days are* 5 *hours*

But it's a little ſtrange, that when *Jupiter* is ſo much bigger than our Planet, their Days and Nights ſhould be but five of our Hours. By this we may ſee that Nature has not obſerv'd that proportion that their bulk ſeems to require, ſeeing in *Mars* the days are very little different from ours. But in the length of their years, that is in the revolution of the Planets round the Sun, there is an exact proportion to their diſtances from the Sun followed. For as the Cubes of their diſtances, ſo are the Squares of their Revolutions, as *Kepler* firſt found out. Which proportion the Moons of *Jupiter* and *Saturn* keep in their Courſes round thoſe Planets. As the Years and Days in *Jupiter* are different from ours in this reſpect, ſo are the Days in another; namely,

Always of the ſame length.

namely, that they are all of the ſame length. For they there enjoy a perpetual Equinox, their Axis having little or no inclination to their Orbit, as the Earth's has, as has bin diſcover'd by Teleſcopes. The Countries that lie near their Poles have little or no heat, by reaſon the Rays of the Sun fall ſo obliquely upon them; but then they are freed from the Inconveniency that ours are troubled with, of tedious long half-year Nights, and have the conſtant returns of Day and Night every five hours. Indeed we ſhould not be contented with ſuch ſhort days, and ſhould count our ſelves very ill dealt with if we had not twice as long, tho upon no other account, but that what is our own, to be ſure, muſt be beſt. Book 2.

The reſt of the Planets are ſo near the Sun, (*Mars* himſelf never being above 18 degrees from it) that in *Jupiter* they have the ſight only of *Saturn*. But we cannot deny but that their four Moons ſtand them in greater ſtead than our one doth us, if 'twere only that they ſeldom know any ſuch thing as to be without Moonſhiny Nights.

Book 2. Nights. And they are of great advantage to them, as we ſaid before, in their Navigation, if they have any ſuch thing. Not to mention the pleaſant ſights of their frequent Conjunctions and Eclipſes, things that they are ſeldom a day without.

Saturn enjoys all thoſe Pleaſures and Advantages in a ſtill higher degree, as well for his five Moons, as for the delightful proſpect that the Ring about him affords his Inhabitants night and day. But we will be as kind to them as we have bin to the reſt of the Planets, in giving an account of their Aſtronomy.

They ſee the fixt Stars juſt as we do.

And firſt of all we ſhall obſerve what we might have remark'd before, but will be more ſtrange here, that the fix'd Stars appear to them of the ſame Figure and Magnitude, and with the ſame degree of Light that they do to us: and this, by reaſon of their immenſe diſtance, of which we ſhall have occaſion to ſpeak by and by. In compariſon with which the ſpace that a Bullet ſhot out of a Cannon could travel in 25 years, would be almoſt nothing. Their

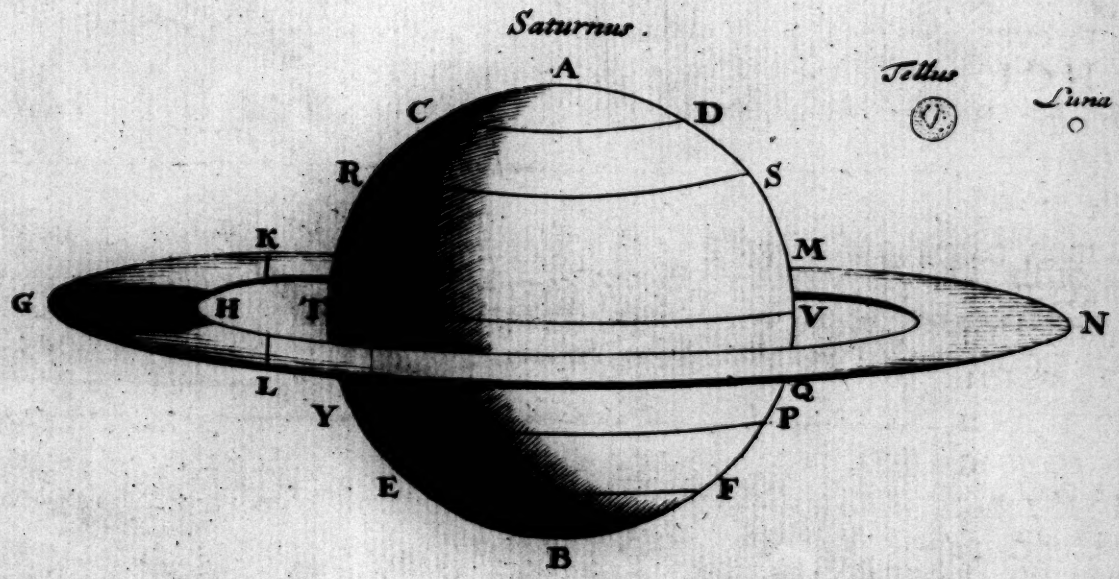
Their Aſtronomers have all the ſame Signs of the Bear, the Lion, Orion, and the reſt, but not turning upon the ſame Axis with us: for that's different in all the Planets. Book 2.

As *Jupiter* can ſee no Planet but *Saturn*, ſo *Saturn* knows of no Planet but *Jupiter*; which appears to him much as *Venus* doth to us, never removing above 37 degrees from the Sun. The length of their days I cannot determine: But if from the diſtance and period of his innermoſt Attendant, and comparing it with the innermoſt of *Jupiter*'s, a Man may venture to give a gueſs, they are very little different from *Jupiter*'s, 10 hours or ſomewhat leſs. But whereas in *Jupiter* theſe are equally divided between Light and Darkneſs, the *Saturnians* muſt perceive a more ſenſible difference than we, eſpecially between Summer and Winter. For our Axis inclines to the place of the Ecliptick but 23 degrees and a half, but there's above 31. Upon this account his Moons muſt decline very much from the Path that the Sun ſeems to move in,

Book 2. in, and his Inhabitants can never have a full Moon but juſt at the Equinoxes: two of which fall out in 30 of our years. 'Tis this Poſition of the Axis too that is the cauſe of thoſe delightful appearances, and wonderful proſpects that its Inhabitants enjoy: for the better underſtanding of which I ſhall draw a Figure of *Saturn* with his Ring about him: in which the proportion between the Diameters of the Globe and Ring is as 9 to 4. And the empty ſpace between them is of the ſame breadth with the Ring it ſelf. All Obſervations conſpire to prove that that is of no great thickneſs, altho if we ſhould allow it ſix hundred German Miles; I think, conſidering its Diameter, we ſhould not overdo the matter.

Fig. 4. Suppoſe then that to be the Globe of *Saturn*, whoſe Poles are A, B. G N is the Diameter of the Ring, as you view it ſideways, repreſenting a narrow Oval. Thoſe that live about the Poles within the Arches C A D, E B F, each of which are 54 degrees, (if the Cold will ſuffer any body to live there)

Fig: 4.



there) never have a ſight of the Ring. From all other parts it is continually to be ſeen for fourteen years and nine Months, which is juſt half their year. The other half it is hid from their view. Thoſe then that dwell between the Polar Circle C D, and the Equator T V, all that time that the Sun enlightens the part oppoſite to them, have every night the ſight of a piece of it H G L, much in the ſhape of a ſhining Bow, which comes from the Horizon, but is darken'd in the middle by the ſhadow of *Saturn* G H, which reaches moſt commonly to the outermoſt rim of it. But after midnight that Shadow by little and little begins to move towards the right hand to thoſe in the Northern, but the left to thoſe in the Southern Hemiſphere. In the morning it diſappears, leaving behind it a likeneſs indeed of a Bow, but much paler and weaker than our Moon is in the day-time. For they, as I ſaid before, have an Atmoſphere, or an Air ſurrounding them enlighten'd by the Sun. Otherwiſe Night and Day they would have their Ring, their

Book 2.

The appearances of the Ring in Saturn.

Book 2. their Moons, and all the fix'd Stars, equally conſpicuous. Another thing that muſt make the ſight of their Ring very curious, is, that by ſome Spots in it, it is diſcover'd to turn round upon it ſelf: A thing that thoſe that are ſo near cannot but take notice of, when we that live at this diſtance can deſcry a great Inequality, the inſide of it being brighter much than the outſide is. When the ſhadow of the Globe falls upon that part of the Ring G H, the ſhadow of the Ring at the ſame time darkens another part of the Globe about P F, which otherwiſe would have the Sun upon it. So that there is always a Zone of the Globe P Y F E, ſometimes of a larger extent than at others, which is depriv'd of the ſight both of the Sun and Ring for a conſiderable time, the latter of which hides ſome part of the Stars from it too. An amazing thing it muſt be, all of a ſudden to have the Sun darken'd, and fall into a pitch-night, without ſeeing any cauſe of ſuch an accident. All which while their Moons are their only Comfort. The other half of the year

year the Hemiſphere T B V enjoys the ſame Light that T A U before did, and then this undergoes thoſe long Eclipſes that that before ſuffer'd. At the Equinoxes, when the Sun is in the ſame Plane with the Ring, the Saturnians cannot well perceive it: no not even we with our Glaſſes, by reaſon of its Darkneſs. This happens when *Saturn*, viewed from the Sun, is advanced one and twenty degrees and a half in *Virgo* or *Piſces*, as I ſhow'd formerly in my Syſtem of *Saturn*: Where there is an account given of the Riſings of the Sun above the Ring, throughout all the Saturnian Year. Book 2.

With *Saturn* in this Scheme you have the Globes of the Earth and Moon drawn in their true proportion, to put you in mind again of a thing very fit to be remember'd, how very ſmall our Habitation is when compar'd with that Globe or the Ring about it. And now any one, I ſuppoſe, can frame to himſelf a picture of the Night in *Saturn*, with two Arches of the Ring, and five Moons ſhining about,

Book 2. about, and adorning him. This then ſhall be what I have to ſay to the primary Planets.

We are now come a little lower, to make an enquiry into the Attendants of theſe Planets, eſpecially our own. And here we ſhall meddle not only with their Aſtronomy, but ſhall alſo ſearch into their Furniture and Ornament, if they are found to have any ſuch thing, which we have put off conſidering till now.

Very little to be ſaid of the Moon.

And here one would think that when the Moon is ſo near us, and by the means of a Teleſcope may be ſo nicely and exactly obſerv'd; it ſhould afford us matter for more probable Conjectures than any of the other remote Planets. But it is quite otherwiſe, and I can ſcarce find any thing to ſay of it, becauſe I have not a Planet of the ſame nature before my eyes, as in all the primary ones I have. For they are of the ſame kind with our Earth; and ſeeing all the Actions, and every thing that is here, we may make a reaſonable Conjecture at what we cannot ſee in thoſe Worlds.

But

But this we may venture to say, without fear, that all the Attendants of *Jupiter* and *Saturn* are of the same nature with our Moon, as going round them, and being carry'd with them round the Sun just as the Moon is with the Earth. Their Likeness reaches to other things too, as you'l see by and by. Therefore whatsoever we can with reason affirm or fancy of our Moon (and we may say a little of it) must be suppos'd with very little alteration to belong to the Guards of *Jupiter* and *Saturn*, as having no reason to be at all inferior to that. Book 2.

The Guards of Jupiter and Saturn of the same nature with our Moon.

The Surface of the Moon then is found, by the least Telescopes of about three or four foot, to be diversified with long Tracts of Mountains, and again with broad Valleys. For in those parts opposite to the Sun you may see the Shadows of the Mountains, and often discover the little round Valleys between them, with a hillock or two perhaps rising out of them. *Kepler* from the exact roundness of them would prove that they are some vast work of the rational

The Moon hath Mountains.

Book 2. Inhabitants. But I can't be of his mind, both for their incredible largeneſs, and that they might eaſily be occaſion'd by natural Cauſes. Nor can I find any thing like Sea there, tho he and many others are of the contrary opinion I know. For thoſe vaſt Countries which appear darker than the other, commonly taken for and call'd by the names of Seas, are diſcover'd with a good long Teleſcope, to be full of little round Cavities; whoſe Shadow falling within themſelves, makes them appear of that colour: and thoſe large Champains there in the Moon you will find not to be always even and ſmooth, if you look carefully upon them: neither of which two things can agree to the Sea. Therefore thoſe Plains in her that ſeem brighter than the other parts, muſt conſiſt, I ſuppoſe, of a whiter ſort of Matter than they. Nor do I believe that there are any Rivers, for if there were, they could never eſcape our ſight, eſpecially if they run between the Hills as ours do. Nor have they any Clouds to furniſh the Rivers with Water.

But no Sea,

Nor Rivers,

Nor Clouds,

Water. For if they had, we ſhould ſometimes ſee one part of the Moon darken'd by them, and ſometimes another, whereas we have always the ſame proſpect of her. Book 2.

Nor Air, and Water.

'Tis certain moreover, that the Moon has no Air or Atmoſphere ſurrounding it as we have. For then we could never ſee the very outermoſt Rim of the Moon ſo exactly as we do, when any Star goes under it, but its Light would terminate in a gradual faint ſhade, and there would be a ſort of a down as it were about it; not to mention, that the Vapors of our Atmoſphere conſiſt of Water, and conſequently that where there are no Seas or Rivers, there can be no Atmoſphere. This is that notable difference between that Planet and us that hinders all probable Conjectures about it. If we could but once be ſure that they had Water, we might come to an Agreement, and plant a Colony perhaps there; we might allow it then moſt of our other Privileges, and, with *Xenophanes*, furniſh it with Inhabitants, Cities, and Mountains. But as 'tis, I

Book 2. cannot imagine how any Plants or Animals, whoſe whole nouriſhment comes from liquid Bodies, can thrive in a dry, waterleſs, parch'd Soil.

The Conjecture of its Plants and Animals very dubious.

What then, ſhall this great Ball be made for, nothing but to give us a little puny light in the Night-time, or to raiſe our Tides in the Sea? Shall not we plant ſome People there that may have the pleaſure of ſeeing our Earth turn upon it ſelf, preſenting them ſometimes with a proſpect of *Europe* and *Africa*, and then of *Aſia* and *America*; ſometimes half, and ſometimes full? What! and muſt all thoſe Moons round *Jupiter* and *Saturn* be condemn'd to the ſame Uſeleſneſs? I do not know what to think of it, becauſe I know of nothing like them to found a Conjecture upon. And yet 'tis not improbable that thoſe great and noble Bodies have ſomewhat or other growing and living upon them, tho very different from what we ſee and enjoy here. Perhaps their Plants and Animals may have another ſort of Nouriſhment there. Perhaps the moiſture of the Earth there is but juſt ſufficient

to

to cauſe a Miſt or Dew, which may be very ſutable to the growth of their Herbs. Which I remember is *Plutarch*'s opinion, in his Dialogue upon this Subject. For in our Earth a very little Water drawn from the Sea into Dew, and falling down again upon the Herbs, would be ſufficient for all our needs, without any Rain or Showers. But theſe are mere gueſſes, or rather doubts, but yet they are the beſt we can make of this, and all thoſe other Moons: for, as I ſaid before, they are all of the ſame nature, which is proved likewiſe by this, that as our Moon can afford us the ſight never but of one ſide of her, ſo they turn always the ſame face to their primary Planets. You wonder, I ſuppoſe, how we came to know ſo much; but 'twas no hard matter, after that Obſervation which I juſt now made, that the outermoſt of *Saturn*'s Moons can never be ſeen but when ſhe is on the Weſt-ſide of her Planet. The reaſon of which is plainly this, that one ſide of her is darker, and does not reflect the Light ſo much as the other.

Book 2.

Jupiter's and Saturn's Moons turn always the ſame ſide to them.

Book 2. which when it is turned towards us, we cannot ſee by reaſon of its weak Light. This always happening when 'tis Eaſt of him, and never on the other ſide, is a manifeſt proof that ſhe always keeps the ſame ſide toward *Saturn*. Now ſince the outermoſt of *Saturn*'s and our Moon carry themſelves thus to the Planets round which they move, who can well doubt it of all the reſt round *Jupiter* and *Saturn*? And there's a very good reaſon for it, namely, that the matter of which thoſe Moons conſiſt, being heavier, and more ſolid on the ſide that is averſe from us, than on that which we have the ſight of, does conſequently fly with a greater force from the Centre of its Motion: for otherwiſe, according to the Laws of Motion, it ſhould turn the ſame ſide always, not to its Planet, but to the ſame fixt Stars.

This Poſition of the Moons, in reſpect of their Planets, muſt occaſion a great many very pretty, wonderful ſights to their Inhabitants, if they have any: which is very doubtful, but may for the preſent be ſuppos'd.

An

An enquiry into our Moon may ſerve for all the reſt. Its Globe is divided into two parts, after that manner, that thoſe who live on one ſide never loſe the ſight of us, and thoſe on the other never enjoy it. Only thoſe who live on the Confines of each of theſe loſe us, and ſee us again by turns. The Earth to them muſt ſeem much larger than the Moon doth to us, as being in Diameter above four times bigger. But the beſt of it is, that night and day they ſee it always in the very ſame part of the Heaven, as if it never moved: ſome of them as if 'twas falling upon their heads: others ſomewhat above the Horizon, and others always in the Horizon, ſtill turning upon it ſelf, and preſenting them every twenty four hours with a view of all its Countries, even of thoſe that lie near the Poles (I could wiſh my ſelf in the Moon only for the ſight of them) yet unknown and undiſcover'd by us. They have it in its monthly Wane and Increaſe, they ſee it half, and horned, and full, by turns, juſt as we do their Planet. But the Light

Book 2.

The Aſtronomy of the Inhabitants of the Moon.

Book 2. that they borrow of us is five times larger than what they pay us again. So that in dark nights that part that hath the advantage of being towards us, receives a very glorious Light, tho let *Kepler* ſay what he will, no Heat from us. Their Days are always of the ſame length with their Nights; and the Sun riſing and ſetting to them but once in one of our Months, makes the time both of their Light and Darkneſs to be equal to 15 of our days. If their Bodies are of the ſame Metal with ours, thoſe that have the Sun pretty high in their Horizon, muſt be like to be burnt up in ſuch long days. For the Sun is not farther from them than he is from us. This will be the caſe of thoſe that live upon the Borders of the two Hemiſpheres we talk'd of; but thoſe that live under the Poles of the Moon will be juſt about as hot as our Whale-Fiſhers about *Iſland* and *Nova Zemla* are, in the Summer-time: who are in ſo little danger of being roaſted, that in the middle of their Summer, in their days of three Months length, they are ready to loſe their fin-

fingers ends. The Poles of the Moon I call thoſe, round which the fixt Stars ſeem to turn to its Inhabitants, which are different from ours, and thoſe of the Ecliptick, altho they move round theſe latter, at the diſtance of five degrees, in a period of nineteen Years. Their Year they count by the Motion of the Stars, and their return to the Sun, and 'tis the ſame with ours. They can eaſily do it, becauſe they have the Stars day and night, notwithſtanding the Light of the Sun: for they have no Atmoſphere (which is the only reaſon that we don't every day enjoy the ſame ſight) to hinder their Obſervations. Nor have they any Clouds to obſtruct their view, ſo that they have an eaſier work than we to find out the Courſes, but a more difficult to make a true Syſtem of the Planets. For they will be apt to lay a wrong Foundation upon the Immobility of the Earth, which will lead them into more dangerous Errors than ever it did us. All that I have ſaid belongs as well to *Jupiter*'s and *Saturn*'s as to our Moon, in reſpect of the

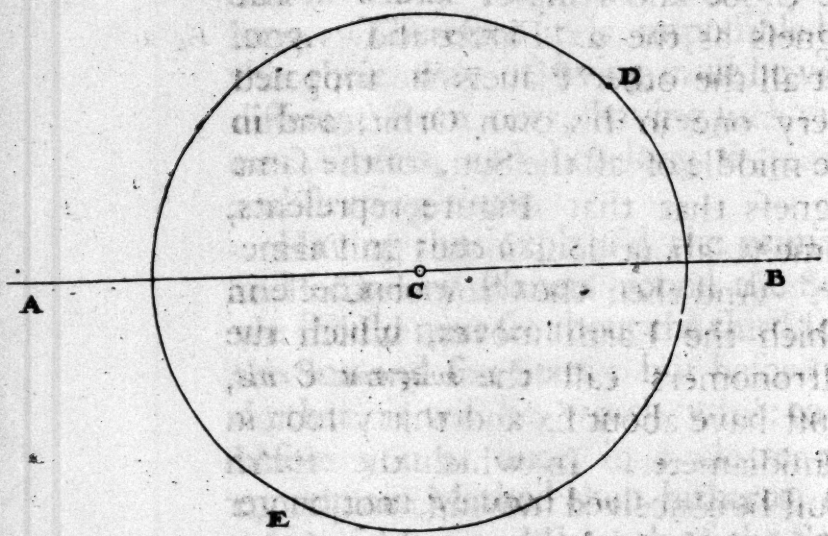
This may be applied to the Moons about Jupiter and Saturn.

Book 2. the Planets they move round. The length of their Day and Night is always equal to the time of their Revolution: for example, the fifth Moon moves round *Saturn* in 80 days, and the days and nights there are equal to forty of ours. Both their Summer and Winter (*Saturn* moving round the Sun in thirty years) are fifteen years long. Therefore it is impoſſible but that their way of living muſt be very different from ours, having ſuch tedious Winters, and ſuch long watching and ſleeping times.

Having thus explain'd the primary and ſecondary Planets round the Sun, we ſhould next ſet about the third ſort, the Sun and fixt Stars; but before we do that, it will be worth while to ſet before you at once, in a clearer and more plain Method than hitherto, the Magnificence and Fabrick of the Solar Syſtem. Which we can't poſſibly do in ſo ſmall a ſpace as one of our Leaves will but admit of, becauſe the Bodies of the Planets are ſo prodigiouſly ſmall in compariſon of their Orbs. But what is wanting in Figure ſhall be made

made

Fig: 5.



made up in Words. Going back then to the first Scheme, suppose another like it, and proportionable, drawn upon a very large smooth Plain; whose outermost Circle representing the Orb of *Saturn*, must be conceived three hundred and sixty foot in Semidiameter. In which you must place the Globe and Ring of *Saturn* of that bigness as the 2*d* Figure shows you. Let all the other Planets be supposed every one in his own Orbit, and in the middle of all the Sun, of the same bigness that that Figure represents, namely, about four inches in Diameter. And then the Orbit or Circle in which the Earth moves, which the Astronomers call the *magnus Orbis*, must have about six and thirty foot in Semidiameter. In which the Earth must be conceived moving, not bigger than a grain of Millet, and her Companion the Moon scarcely perceivable, moving round her in a Circle a little more than two Inches broad, as in the Figure here adjoined, where the line A B represents a small portion of that Circle which the Earth moves in: the

Book 2.

Fig. 1.

Fig. 2.

Fig. 3.

Book 2. the ſmall Circle therein C is the Earth, and the Circle D E the path of the Moon round it, in which the body of the Moon is D.

The outermoſt of *Saturn*'s Moons moves in an Orbit whoſe Semidiameter is 29 inches; that of *Jupiter* in a ſomewhat ſmaller, whoſe Semidiameter is 19 and a quarter.

And thus we have a true and exact Deſcription of the Sun's Palace, where the Earth will be twelve thouſand of its Semidiameters diſtant from him, which in German Miles makes above ſeventeen Millions. But perhaps we may have a clearer comprehenſion of this vaſt length, by comparing it with ſome very ſwift Motion. 'Twas a pretty fancy of *Heſiod*, that an Anvil let fall from the top of Heaven, reach'd the Earth the tenth day of its Journey, and in ten more arriv'd at the bottom of Hell, the end of it: ſo making the Earth the midway between Heaven and Hell. I ſhan't make uſe of the Anvil, but of one as good, namely, a Bullet ſhot out of a great Gun, which may travel perhaps

haps in a moment, or pulse of an Artery, about a hundred Fathom, as is prov'd by those Experiments that *Mersennus* in a Treatise of his relates; wherein the Sound was found to extend it self eighty hundredth parts in that time. I say then, that supposing a Bullet to move with this swiftness from the Earth to the Sun, it would spend 25 years in its passage. To make a Journey from *Jupiter* to the Sun, would require 125, and from *Saturn* thither 256 years. This account depends upon the measure of the Earth's Diameter, which, according to the accurate Observations of the French, is 6538594 times six *Paris* feet, one degree being 57060 of that measure. This shows us how vast those Orbs must be, and how inconsiderable this Earth, the Theatre upon which all our mighty Designs, all our Navigations, and all our Wars are transacted, is when compared to them. A very fit Consideration, and matter of Reflection, for those Kings and Princes who sacrifice the Lives of so many People, only to flatter their Ambition in being Masters

The immense distance between the Sun and Planets illustrated.

Book 2. Maſters of ſome pitiful corner of this ſmall Spot. But to return to the matter in hand, now we have given you an account of the Sun's proportion to thoſe Orbs and Bodies, we'll ſee what more we can ſay of him.

No ground for Conjecture in the Sun.

And there are ſome that have bin ſo civil, as to allow the Sun himſelf his Inhabitants. But upon what reaſon I cannot imagine, there being leſs ground for a probability in him than in the Moon. For we are not yet ſure, whether he be a compact or liquid Globe; altho, if my account of Light be true, upon that account I ſhould rather think him liquid: which his roundneſs and equal diſtribution of his Light to all parts are an Argument for. For that inequality on his Surface, which is diſcover'd by the Teleſcopes, (and that not always neither) which makes men fancy boiling Seas and belching Mountains of Fire, is nothing but the trembling Motion of the Vapors our Atmoſphere is full of near the Earth; which is likewiſe the cauſe of the Stars twinkling. Nor could I ever have the luck to diſcern thoſe bright

The Faculæ *in the Sun not eaſily ſeen.*

bright Spots they brag ſo much of in the Sun as well as of his dark ones, tho the latter I have very often ſeen; ſo that with very good reaſon I can doubt whether there's any ſuch thing. For, in all the exact Obſervations, I could never find any ſuch pretended to be ſeen any where but juſt about his dark Spots; and it is no great wonder that thoſe Parts which are ſo near the darker, ſhould appear ſomewhat brighter than the reſt. That the Sun is extremely hot and firy, is beyond all diſpute, and ſuch Bodies as ours could not live one moment in ſuch a Furnace. We muſt make a new ſort of Animals then, ſuch as we have no Idea or Likeneſs of among us, ſuch as we can neither imagine nor conceive: which is as much as to ſay, that truly we have nothing at all to ſay. No doubt that glorious and vaſt Body was made for ſome noble end and uſe, and fram'd with excellent deſign. And I think we all very well know and feel its Uſefulneſs in that effuſion of Light and Heat to all the Planets round it; in the preſervation and happineſs of all living

Book 2.

By reaſon of its Heat no Inhabitants like ours can live in the Sun.

Book 2. living Creatures, and that not only in our Ball, but in thoſe vaſt Globes of *Jupiter* and *Saturn*, not much inferior to its own. Theſe are ſuch great, ſuch wiſe ends, that it is not ſtrange that the Sun ſhould have bin made, if it had bin only upon their account. For, as for *Kepler*'s fancy, that he hath another Office, namely, to help on the Motion of the Planets in their own Orbs, by turning them round their Axis, (which he would fain eſtabliſh in his Epitome) I ſhall give good Reaſons why I cannot aſſent to it.

The fix'd Stars ſo many Suns.

Before the invention of Teleſcopes, it ſeem'd to contradict *Copernicus*'s Opinion, to make the Sun one of the fix'd Stars. For the Stars of the firſt Magnitude being eſteemed to be about three minutes Diameter; and *Copernicus* (obſerving that tho the Earth changed its place, they always kept the ſame diſtance from us) having ventur'd to ſay that the *Magnus Orbis* was but a point in reſpect of the Sphere in which they were placed, it was a plain conſequence that every one of them that appeared any thing bright, muſt be

be larger than the Path or Orbit of the Earth: which is very abſurd. This is the topping Argument that *Tycho Brahe* ſet up againſt *Copernicus*. But when the Teleſcopes ſhav'd them of their fictitious Rays, and ſhow'd 'em to us bare and naked (which they do beſt when the Eye-glaſs is black'd with Smoke) juſt like little ſhining Points, then that difficulty vaniſhed, and the Stars might ſtill be Suns. Which is the more probable, becauſe their Light is certainly their own: for it's impoſſible that ever the Sun ſhould ſend, or they reflect it at ſuch a vaſt diſtance. This is the opinion that commonly goes along with *Copernicus*'s Syſtem. And the Patrons of it do alſo with reaſon ſuppoſe, that all theſe Stars are not in the ſame Sphere, as well becauſe there's no Argument for it, as that the Sun, which is one of them, cannot be brought to this Rule. But it's more likely they are ſcatter'd and diſperſed all over the immenſe ſpaces of the Heaven, and are as far diſtant perhaps from one another, as the neareſt of them are from the Sun.

Book 2.

They are not all in the ſame Sphere.

Book 2. Here again too I know *Kepler* is of another opinion in his Epitome of *Copernicus*'s Syſtem, that we mention'd above. For tho he agrees with us, that the Stars are diffus'd through all the vaſt Profundity, yet he cannot allow that they have as large an empty ſpace about them as our Sun has. For at that rate, 'twas his opinion, we ſhould ſee but very few, and thoſe of very different Magnitudes: *For, ſeeing the largeſt of all appear ſo ſmall to us, that we can ſcarce obſerve or meaſure them with our beſt Inſtruments; how muſt thoſe appear that are three or four times farther from us? Why, ſuppoſing them no larger than theſe, they muſt ſeem three or four times leſs, and ſo on till a little farther they will not be to be ſeen at all: Thus we ſhall have the ſight of but very few Stars, and thoſe very different one from another*; Whereas we have thouſands, and thoſe not conſiderably bigger or leſs than one another. But this by no means proves what he would have it; and his miſtake was chiefly, that he did not conſider the nature of Fire, which makes it be ſeen at ſuch diſtances,

distances, and at such small Angles as all other Bodies would totally disappear under. A thing that we need go no farther than the Lamps set along the Streets to prove. For altho they are a hundred foot from one another, yet you may count twenty of them in a continued row with your eyes, and yet the twentieth of them scarce makes an Angle of six Seconds. Certainly then the glorious Light of the Stars must do much more than this; so that it's no wonder we should see a thousand or two of them with our bare eyes, and with a Telescope discover twenty times that number. But *Kepler* had a private design in making the Sun thus superior to all the other Stars, and planting it in the middle of the World, attended with the Planets: a favor that he did not desire to grant the rest. For his aim was by it to strengthen his Cosmographical Mystery, that the distances of the Planets from the Sun are in a certain proportion to the Diameters of the Spheres that are inscrib'd within, and circumscrib'd about *Euclid*'s Polyedrical Bodies. Book 2.

Book 2. Which could never be ſo much as probable, except there were but one Chorus of Planets moving round the Sun, and ſo the Sun were the only one of his kind.

But that whole Myſtery is nothing but an idle Dream taken from *Pythagoras* or *Plato*'s Philoſophy. And the Author himſelf acknowleges that the Proportions do not agree ſo well as they ſhould, and is fain to invent two or three very ſilly excuſes for it. And he uſes yet poorer Arguments to prove that the Univerſe is of a ſpherical Figure, and that the number of the Stars muſt neceſſarily be finite, becauſe the Magnitude of each of them is ſo. But what is worſt of all is, that he ſettles the ſpace between the Sun and the concavity of the Sphere of the fix'd Stars, to be ſix hundred thouſand of the Earth's Diameters. For this very good reaſon, forſooth, that as the Diameter of the Sun is to that of the Orbit of *Saturn*, which he makes to be as 1 to 2000, ſo is this Diameter to that of the Sphere of the fix'd Stars. A mere fancy without any ſhadow of Reaſon.

Reaſon. I cannot but wonder how ſuch things as theſe could fall from ſo ingenious a Man, and ſo great an Aſtronomer. But I muſt give my Vote, with all the greateſt Philoſophers of our Age, to have the Sun of the ſame nature with the fix'd Stars. And this will give us a greater Idea of the World, than all thoſe other Opinions. For then why may not every one of theſe Stars or Suns have as great a Retinue as our Sun, of Planets, with their Moons, to wait upon them? Nay there's a manifeſt reaſon why they ſhould. For let us fancy our ſelves placed at an equal diſtance from the Sun and fix'd Stars; we ſhould then perceive no difference between them. For, as for all the Planets that we now ſee attend the Sun, we ſhould not have the leaſt glimpſe of them, either that their Light would be too weak to affect us, or that all the Orbs in which they move would make up one lucid point with the Sun. In this ſtation we ſhould have no occaſion to imagine any difference between the Stars, and ſhould make no doubt if we

Book 2.

The Stars have Planets about them like our Sun.

Book 2. had but the ſight, and knew the nature of one of them, to make that the Standard of all the reſt. We are then plac'd near one of them, namely, our Sun, and ſo near as to diſcover ſix other Globes moving round him, ſome of them having others performing them the ſame Office. Why then ſhall not we make uſe of the ſame Judgment that we would in that caſe; and conclude, that our Star has no better attendance than the others? So that what we allow'd the Planets, upon the account of our enjoying it, we muſt likewiſe grant to all thoſe Planets that ſurround that prodigious number of Suns. They muſt have their Plants and Animals, nay and their rational ones too, and thoſe as great Admirers, and as diligent Obſervers of the Heavens as our ſelves; and muſt conſequently enjoy whatſoever is ſubſervient to, and requiſit for ſuch Knowlege.

What a wonderful and amazing Scheme have we here of the magnificent Vaſtneſs of the Univerſe! So many Suns, ſo many Earths, and every one of them ſtockd with ſo many Herbs,

Herbs, Trees and Animals, and adorn'd with so many Seas and Mountains! And how must our wonder and admiration be encreased when we consider the prodigious distance and multitude of the Stars? Book 2.

That their distance is so immense, that the space between the Earth and Sun (which is no less than twelve thousand of the former's Diameters) is almost nothing when compar'd to it, has more Proofs than one to confirm it. And this among the rest. If you observe two Stars near one another, as for example those in the middle of the Great Bears Tail, differing very much from one another in Clearness, notwithstanding our changing our Position in our Annual Orbit round the Sun, and that there would be a Parallax were the Star which is brighter nearer us than the other, as is very probable it is, yet whatever part of the year you look upon them, they will not in the least have altered their distance. Those that have hitherto undertook to calculate their Distance, have not bin able perfectly to

Book 2. compaſs their deſign, by reaſon of the extreme niceneſs and almoſt impoſſibility of the Obſervations requiſite for their purpoſe. The only Method that I ſee remaining, to come at any tolerable probability in ſo difficult a caſe, I ſhall here make uſe of. Seeing then that the Stars, as I ſaid before, are ſo many Suns, if we do but ſuppoſe one of them equal to ours, it will follow that its diſtance from us is as much greater than that of the Sun, as its apparent Diameter is leſs than the Diameter of the Sun. But the Stars, even thoſe of the firſt Magnitude, tho view'd through a Teleſcope, are ſo very ſmall that they ſeem only like ſo many ſhining Points, without any perceivable breadth. So that ſuch Obſervations can here do us no good. When I ſaw this would not ſucceed, I ſtudied by what way I could ſo leſſen the Diameter of the Sun, as to make it not appear larger than the Dog, or any other of the chief Stars. To this purpoſe I clos'd one end of my twelve-foot Tube with a very thin Plate, in the middle of which I made a hole not ex-

A way of making a probable gueſs at the diſtance of the Stars.

exceeding the twelfth part of a Line, Book 2.
that is the hundred and forty fourth
part of an Inch. That end I turn'd
to the Sun, placing my Eye at the
other, and I could ſee ſo much of the
Sun as was in Diameter about the 182*d*
part of the whole. But ſtill that lit-
tle piece of him was brighter much
than the Dog-Star is in the cleareſt
night. I ſaw that this would not do,
but that I muſt leſſen the Diameter of
the Sun a great deal more. I made
then ſuch another hole in a Plate, and
againſt it I plac'd a little round Glaſs
that I had made uſe of in my Micro-
ſcopes, of much about the ſame Dia-
meter with the former hole. Then
looking again towards the Sun (taking
care that no Light might come near
my eye to hinder my Obſervation) I
found it appear'd of much the ſame
Clearneſs with *Sirius*. But caſting up
my account, according to the Rules of
Dioptricks, I found his Diameter now
was but $\frac{1}{1331}$ part of that hundred and
eighty ſecond part of his whole Dia-
meter that I ſaw through the former
hole. Multiplying $\frac{1}{1331}$ and $\frac{1}{1331}$ into
one

Book 2. one another, the Product I found to be $\frac{1}{27664}$. The Sun therefore being contracted into ſuch a compaſs, or being removed ſo far from us (for it's the ſame thing) as to make his Diameter but the 27664 part of that we every day ſee, will ſend us juſt the ſame Light as the Dog-ſtar now doth. And his diſtance then from us will be to his preſent diſtance undoubtedly as 27664 is to 1; and his Diameter little above four thirds, 4‴. Seeing then *Sirius* is ſuppoſed equal to the Sun, it follows that his Diameter is likewiſe 4‴, and that his diſtance to the diſtance of the Sun from us is as 27664 to 1. And what an incredible diſtance that is, will appear by the ſame way of reaſoning that we uſed in meaſuring that of the Sun. For if 25 years are required for a Bullet out of a Cannon, with its utmoſt Swiftneſs, to travel from the Sun to us; then by multiplying the number 27664 into 25, we ſhall find that ſuch a Bullet would ſpend almoſt ſeven hundred thouſand years in its Journey between us and the neareſt of the fix'd Stars.

Stars. And yet when in a clear night we look upon them, we cannot think them above ſome few miles over our heads. What I have here enquir'd into, is concerning the neareſt of them. And what a prodigious number muſt there be beſides of thoſe which are placed ſo deep in the vaſt ſpaces of Heaven, as to be as remote from theſe as theſe are from the Sun! For if with our bare Eye we can obſerve above a thouſand, and with a Teleſcope can diſcover ten or twenty times as many; what bounds of number muſt we ſet to thoſe which are out of the reach even of theſe Aſſiſtances! eſpecially if we conſider the infinite Power of God. Really, when I have bin reflecting thus with my ſelf, methoughts all our Arithmetick was nothing, and we are vers'd but in the very Rudiments of Numbers, in compariſon of this great Sum. For this requires an immenſe Treaſury, not of twenty or thirty Figures only, in our decuple Progreſſion, but of as many as there are Grains of Sand upon the ſhore. And yet who can ſay, that Book 2.

even

Book 2. even this number exceeds that of the Fixt Stars? Some of the Antients, and *Jordanus Brunus* carry'd it further, in declaring the Number infinite: he would perſwade us that he has prov'd it by many Arguments, tho in my opinion they are none of them concluſive. Not that I think the contrary can ever be made out. Indeed it ſeems to me certain, that the Univerſe is infinitely extended; but what God has bin pleas'd to place beyond the Region of the Stars, is as much above our Knowlege, as it is our Habitation.

Or what if beyond ſuch a determinate ſpace he has left an infinite Vacuum; to ſhow, how inconſiderable all that he has made is, to what his Power could, had he ſo pleas'd, have produc'd? But I am falling, before I am aware, into that intricate Diſpute of Infinity: Therefore I ſhall wave this, and not, as ſoon as I am free of one, take upon me another difficult Task. All that I ſhall do more is to add ſomewhat of my opinion concerning the World, as it is a place for the reception of the Suns or fix'd Stars,

every

every one of which, I have ſhow'd may have their Planetary Syſtems about them. Book 2.

I am of opinion then that every Sun is ſurrounded with a Whirl-pool or Vortex of Matter in a very ſwift Motion; tho not in the leaſt like *Cartes*'s either in their bulk, or manner of Motion. For *Cartes* makes his ſo large, as every one of them to touch all the others round them, in a flat Surface, juſt as you have ſeen the Bladders that Boys blow up in Soap-ſuds do: and would have the whole Vortex to move round the ſame way. But the Angles of every Vortex will be no ſmall hindrance to ſuch a Motion. Then the whole matter moving round at once, upon the Axis as it were of a Cylinder, did not a little puzzle him in giving Reaſons for the Roundneſs of the Sun: which however they may ſatisfy ſome People that do not conſider them, really prove nothing of the matter. In this æthereal matter the Planets float, and are carry'd round by its motion: and the thing that keeps them in their own Orbs is, that they them-

Every Sun has a Vortex round it, very different from thoſe of Cartes.

Book 2. themſelves, and the matter in which they ſwim, equally ſtrive to fly out from the Center of this Motion. Againſt all which there are many Aſtronomical Objections, ſome of which I touch'd upon in my Eſſay of the Cauſes of Gravity. Where I gave another account of the Planets not deſerting their own Orbs; which is their Gravitation towards the Sun. I ſhow'd there the Cauſes of that Gravitation, and cannot but wonder that *Carter*, the firſt man that ever began to talk reaſonably of that matter, ſhould never meddle with, or light on it. *Plutarch* in his Book of the Moon abovementioned ſays, that ſome of the Antients were of opinion, that the reaſon of the Moon's keeping her Orbit was, that the force of her Circular Motion was exactly equal to her Gravity, the one of which pull'd her to, as much as the other forc'd her off from the Centre. And in our Age *Alphonſus Borellus*, who was of this ſame opinion in the other Planets as well as the Moon, makes the Gravitation of the primary Planets to be towards the Sun, as that of the ſecondary is towards the Planets round which they move: Which Mr. *Iſaac Newton* has more fully explained, with a great deal of pains and ſubtilty; and how from that cauſe proceeds the Ellipticity of the Orbs of the Planets, found out by *Kepler*. According to my Notion of the Gravitation

vitation of the Planets to the Sun, the matter of his Vortex must not all move the same way, but after such a manner as to have its parts carry'd different ways on all sides. And yet there is no fear of its being destroy'd by such an irregular motion, because the Æther round it, which is at rest, keeps the parts of it from flying out. With the help of such a Vortex as this I have pretended in that Essay to explain the Gravity of Bodies on this Earth, and all the effects of it. And I suppose there may be the same cause as well of the Gravitation of the Planets, and of our Earth among the rest, towards the Sun, as of their Roundness: a thing so very hard to give an account of in *Cartes*'s System. Book 2.

I must differ from him too in the bigness of the Vortices, for I cannot allow them to be so large as he would make them. I would have them dispers'd all about the immense space, like so many little Whirlpools of Water, that one makes by the stirring of a stick in any large Pond or River, a great way distant from one another. And as their motions do not all intermix or communicate with one another; so in my opinion must the Vortices of Stars be plac'd as not to hinder one anothers free Circumrotations.

So that we may be secure, and never fear that they will swallow up or destroy one another; for that was a mere fancy of *Cartes*'s,

Book 2. *tes*'s, when he was a ſhowing how a fix
Star or Sun might be turn'd into a Plan
And 'tis plain, that when he writ it,
had no thoughts of the immenſe diſtance
the Stars from one another; particular
by this one thing, that he would have a C
met as ſoon as ever it comes into our Vo
tex, to be ſeen by us. Which is as abſu
as can be. For how could a Star, whi
gives us ſuch a vaſt Light only from the R
flection of the Beams of the Sun, as he hi
ſelf owns they do; how I ſay could that
ſo plainly ſeen at a diſtance ten thouſa
times larger than the Diameter of t
Earth's Orbit? He could not but kno
that all round the Sun there is a vaſt Exte
ſum; ſo vaſt, that in *Copernicus*'s Syſte
the *magnus Orbis*, is counted but a point
compariſon with it. But indeed all t
whole ſtory of Comets and Planets, a
the Production of the World, is founde
upon ſuch poor and trifling grounds, that
have often wonder'd how an ingenious ma
could ſpend all that pains in making ſuc
fancies hang together. For my part, I ſha
be very well contented, and ſhall count
have done a great matter, if I can but com
to any knowlege of the nature of thing
as they now are, never troubling my hea
about their beginning, or how they wer
made, knowing that to be out of the reac
of human Knowlege, or even Conjecture.

FINIS.

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